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PHASE 1 SYSTEM REQUIREMENTS DOCUMENT

for the

U.S. NATIONAL DATA CENTER

Document Number 1000607

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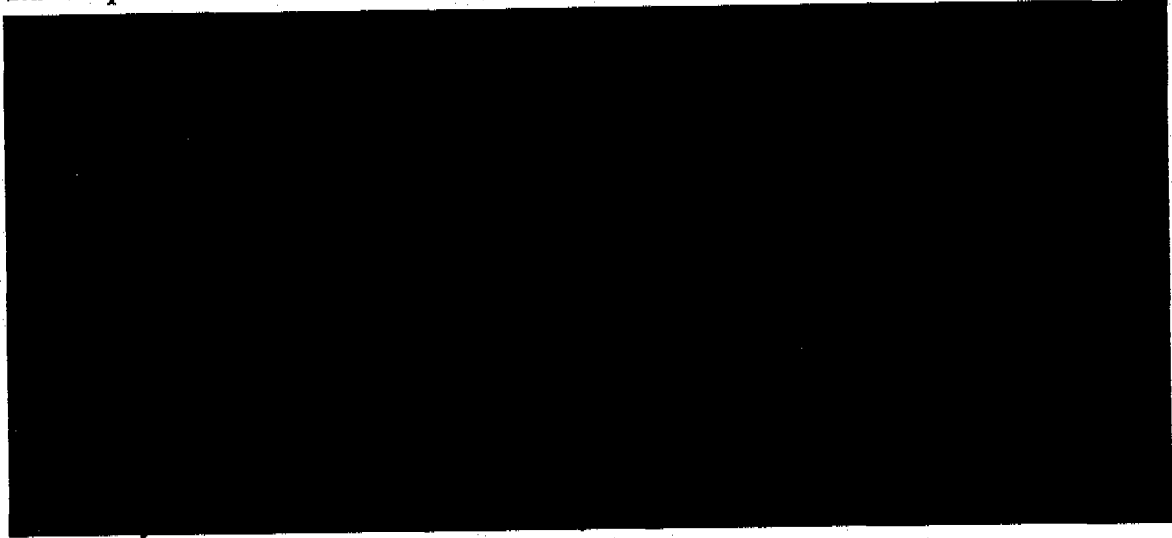
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1.0 INTRODUCTION

1.1 Scope



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1.2 Program Background

The ADSN program was created in response to a 5 August 1986 Air Staff tasking to reduce the high O&M costs of the Technical Operating Subsystem/Global Subsurface System. The ADSN was designed to accept data from existing USAEDS stations. It has been developed to within [REDACTED] of its capacity and has no program planned or in place to expand. The CTBT has recently been negotiated and AFTAC has been tasked to provide the treaty monitoring function. The model for CTBT monitoring has been tested since 1995 under the Group of Scientific Experts Third Technical Test (GSETT-3) and has evolved into the Phase 1 US NDC development program. The Phase 1 US NDC has participated in GSETT-3 since 1 January 1995 by receiving, transmitting, and archiving data from US stations participating in the program. [REDACTED]

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[REDACTED] Data from the first US arrays at Lajitas, TX, and Pinedale, WY, [REDACTED]

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[REDACTED] In addition, the Russian Federation and the United States of America signed a bilateral agreement in October 1996 governing installation of several host-operated, jointly funded arrays on Russian territory. The first of these Russian USAEDS/IMS arrays is scheduled to be installed at Peleduy and should be ready to provide data by mid-1998. [REDACTED]

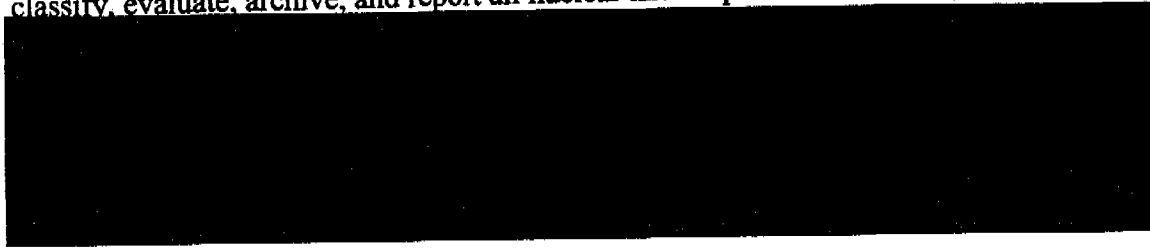
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[REDACTED] To meet these requirements within the next 15 months, AFTAC must begin a phase-in of the Phase 1 US NDC beginning in the second quarter of 1998. Each phase will end with the delivery to AFTAC of an operational capability commensurate with requirements levied on each phase. This phased approach follows the "Pre-planned Program Improvements" model

and provides the flexibility in capacity and capability essential to meet more stringent requirements imposed on the Phase 1 US NDC by US treaty verification agencies. The first part of the phase-in will transfer the data analysis platform to the Phase 1 US NDC to provide additional processing capacity. This will enable the system to accept additional subsurface data as soon as the data are available at AFTAC. To meet flexibility requirements, the Phase 1 US NDC processing system has been designed to maintain dual processing pipelines at all times. One will be designated the operational pipeline while the other serves as the testbed. When appropriate, the testbed and operational pipelines will switch functions. This phase-in will result in the retirement or absorption of the current ADSN HQ processing system into the US NDC by CTBT Entry-Into-Force, now expected to occur in January 1999.

1.3 Mission

AFTAC is tasked with monitoring compliance with existing and future nuclear testing treaties. To perform this mission, AFTAC uses several different monitoring techniques, each designed to monitor a specific physical domain (e.g., space, atmosphere, oceans, underground, etc.) for nuclear explosions. These techniques together form the USAEDS. The fundamental activities performed in carrying out this mission are to detect, locate, classify, evaluate, archive, and report all nuclear and suspected nuclear events.



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1.4 Requirements

The requirements for the Phase 1 US NDC identify functions to be performed and the design constraints to be placed on the finished products. The modular design will support a flexible system whose capability can easily incorporate additional stations and new processing algorithms. The entries in this SRD that must be met by the delivered Phase 1 US NDC system are listed as requirements. If the developer cannot meet any requirement within the negotiated costs and schedules, they will notify the AFTAC program manager. The program manager will then coordinate changes to requirements using established configuration management practices.

1.5 Document Organization

The remainder of this document groups requirements into several broad areas. Section 2 describes the external interfaces that communicate with the Phase 1 US NDC. Section 3 defines the functions the Phase 1 US NDC must successfully perform. Section 4 specifies requirements for the closely related areas of reliability and maintainability. Section 5 addresses security concerns. Section 6 discusses the Phase 1 US NDC's physical environment. Sections 7 and 8 cover general software and human factors that

apply throughout the system. Section 9 discusses requirements for documenting the Phase 1 US NDC.

1.6 Subsurface Subsystems

The subsurface sensor equipment that interfaces with the Phase 1 US NDC is located in widely dispersed geographical locations. These various locations form logical subsystems that perform different parts of the overall subsurface mission. The following definitions should help in identifying the various subsystems.

1.6.1 Field Subsystem



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1.6.2 Phase 1 US NDC

The Phase 1 US NDC, located at AFTAC headquarters, is the central focus of the overall subsurface system. It provides a central point for collecting and analyzing global subsurface data. The Phase 1 US NDC also provides training and software maintenance support for the system.

1.6.3 Auxiliary Headquarters Subsystem

AFTAC requires a capability to continue Phase 1 US NDC operations in the event normal headquarters operations are interrupted (e.g., by a natural disaster) [AFTA85]. To provide this capability, the computer system at the Auxiliary Headquarters site shall include a subset of the headquarters' functionality sufficient to cover operations.


1.6.4 Communications Subsystem

The field, headquarters, and auxiliary headquarters subsystems will be linked together by the communications subsystem. This subsystem will provide reliable data transmission between the various components of the subsurface system and, because of the geographic separation between components, will form a wide-area network.

1.7 Reference Documents

The following documents provide helpful information, ideas, and concepts relevant to subsurface system definition and design. They should not be construed as defining additional system requirements or indicating a pre-conceived Phase 1 US NDC solution. The list below is also not intended to be a complete list of all relevant documents.

- Network Definition Document for the United States National Data Center (Phase 2), 22 Oct 99

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- [AFTAA] (AFTAC letter), AFTAC Computer Communications Systems Architecture
- [AFTAB] AFTAC, AFTAC Seismic Data Formats - NORTPU
- [DoD85] "DoD Trusted Computer System Evaluation Criteria", DoD 5200.28-STD, 1985
- [FIPS127] FIPS 127, Database Structured Query Language (SQL)
- Controlled Access Protection, AFSSI 5002, 26 August 1996
- AFM 33-270, Command, Control, Communications, and Computers (C4) Systems Security Glossary, 8 August 1994

2.0 EXTERNAL INTERFACE REQUIREMENTS

This section identifies Phase 1 US NDC interface requirements. Subsections 2.1 through 2.4 define the sources (producers) of data and Subsections 2.5 through 2.6 define user (consumer) interfaces.

2.1 *Intrasite Communications Interface*

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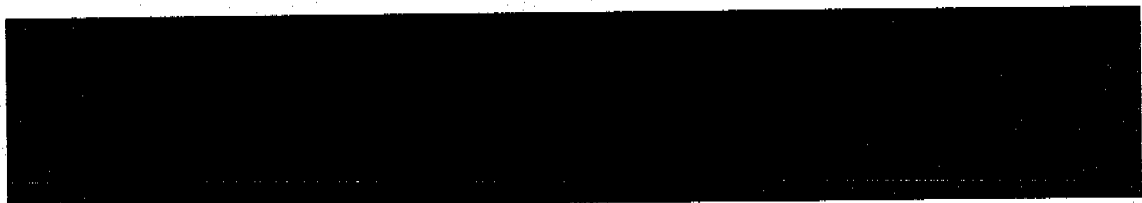
RI2.1.b Deleted, SCN NDC-99-001

RI2.1.c The Phase 1 US NDC shall acquire and process data from the sensors listed in Table 1A.

RI2.1.c.1 The US NDC shall provide the capability to acquire and process those stations listed in the Network Definition Document for the United States National Data Center through 1 February 2003. **(Phase 1 Upgrade)**

RI2.1.d The Phase 1 US NDC shall receive the digital seismic and State-of-Health data from each seismometer for those stations which provide State-of-Health data (AFTAC Southern Network (ASN) and USAEDS only).

RI2.1.e The Phase 1 US NDC shall have the capability to transmit calibration and other control signals to the instrument site for those stations controlled by AFTAC.



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RI2.1.g All waveform data forwarded to the PIDC and/or the VIDC from the US NDC shall use the Alpha protocol.

The USAEDS "O" Technique system currently consists of six unattended field sites, each of which has a small computer with amplifiers, analog-to-digital converters, a modem, and other equipment which captures and digitizes hydrophone data and transmits them to AFTAC Headquarters over leased land lines.

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Field Site	Det/EL	Station	Number of Instruments	Sampling Rate
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SP = short period seismometer
LP = long period seismometer KS 36000, KS54000 or other
BB = broadband seismometer KS36000, KS54000 or other

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Table 1A: USAEDS Seismic Network Sensors as of December 1996

RI2.2.a The Phase 1 US NDC processing platform shall acquire and analyze hydroacoustic data, allowing association of hydroacoustic waveforms with seismic events.

RI2.2.b In the second quarter FY 1998, the Phase 1 US NDC shall accept, process, and archive data from the hydroacoustic network listed in Table 2.

2.3 Headquarters Outside Data Inputs

Data from the sources below arrive in a variety of formats and with unpredictable time delays.

RI2.3.a The Phase 1 US NDC shall support the input of alphanumeric data from outside sources (e.g., Norsar, NEIS, etc.).

2.4 Seismic Data Archive Interface

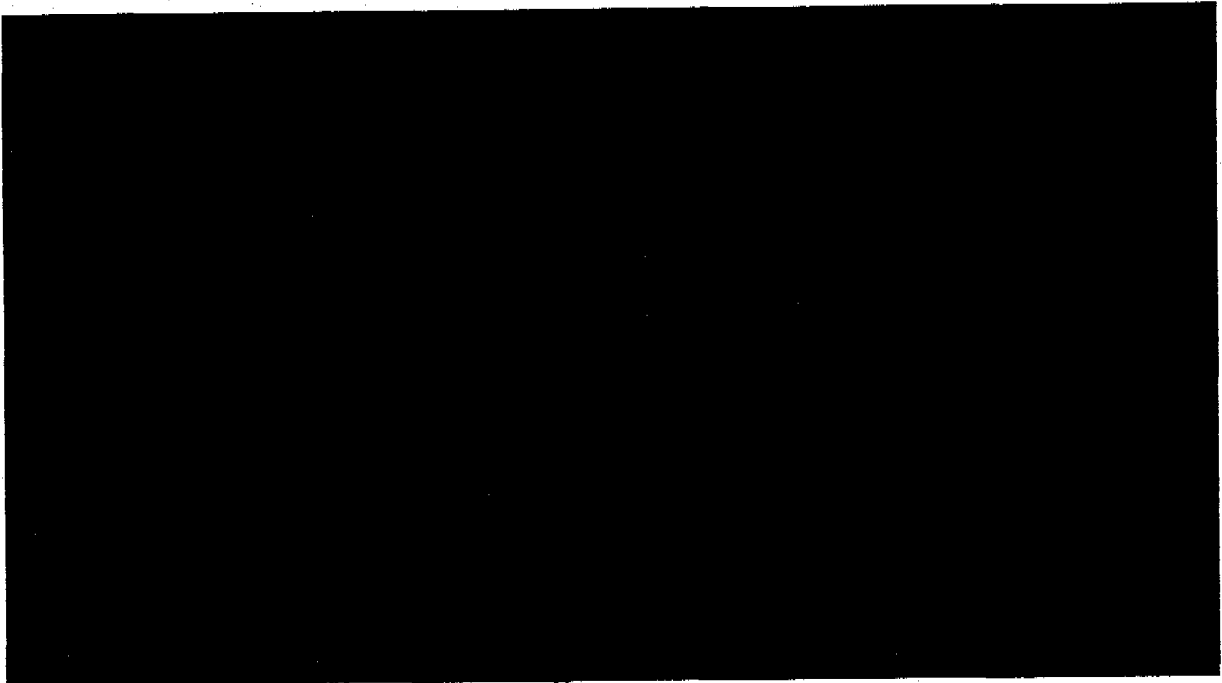
RI2.4.a The Phase 1 US NDC shall be capable of reading waveform and alphanumeric data from the ADSN and US NDC archive.

2.5 AFTAC Headquarters Network Interface

Other AFTAC users (e.g., those on the TT Local Area Network (LAN) and developers of the Phase 1 US NDC) will use this interface for access to seismic and hydroacoustic data needed for completion of their mission. The actual connection of these interfaces will be dependent on approval from the Designated Approving Authority (DAA).

RI2.5.a The Phase 1 US NDC shall support an interface to the existing AFTAC Headquarters [REDACTED]. The interface shall support electronic mail and, in read mode only, the transfer of data files and direct access to the database.

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2.6 User Interface

The Phase 1 US NDC User Interface Requirements are defined in the Human Factors Requirements, Section 8.2.

3.0 FUNCTIONAL REQUIREMENTS

3.1 Data Acquisition

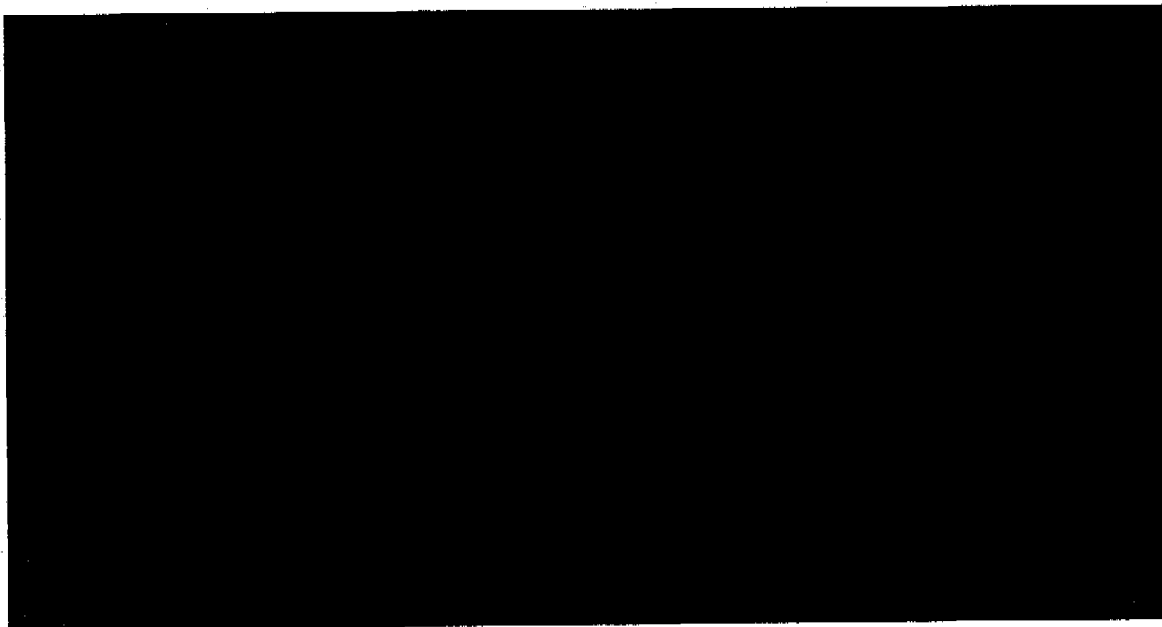
The Phase 1 US NDC must be capable of reliable acquisition of near-real-time data from a global network of sensors. It will use the existing DAS on the ADSN headquarters processing subsystem to acquire data from existing USAEDS stations. The DAS for the Phase 1 US NDC will also include a substantial data acquisition system to handle data from IMS stations. This DAS must also reliably relay and distribute all data received to automated processes and other users.

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The DAS is defined, for the purposes of these requirements, as the hardware and software needed to acquire, organize, and distribute waveform data for the Phase 1 US NDC. The front end is the communications interface to Wide Area Networks (WANs). The dividing point between these WANs and the DAS is anticipated to be the communications routers that place these data onto LANs within the Phase 1 US NDC. Communications services to outside systems, along with the operation of external data

sources, is outside the scope of the DAS. The DAS is intimately linked with the Data Management System (see paragraph 3.2) and together they are responsible for all of the internal storage and movement of waveform data within the Phase 1 US NDC. It also has responsibility for providing these data to other users in a timely fashion. The interface dividing the DAS and these users is considered to be the database and computer file systems. The DAS also interfaces to users/operators through its own dedicated interfaces.



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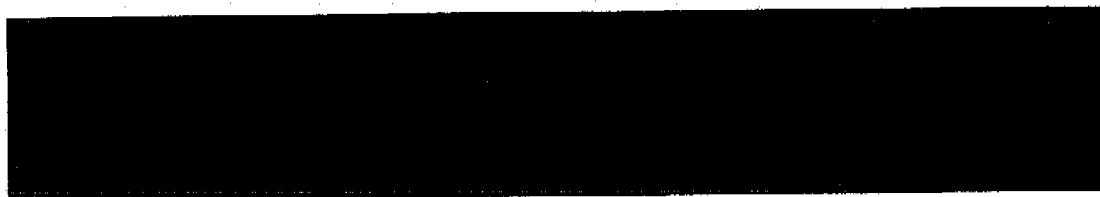
3.1.1.2 Ancillary Data Acquisition. The majority of Phase 1 US NDC data consists of waveform or sampled data, but additional data is collected for performance and maintenance support.



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RI3.1.1.2.b The DataAcq subsystem shall have the capability to monitor data quality parameters and information as recorded during the Data Control functions.

3.1.1.3 Data Forwarding



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RI3.1.1.3.c The DataAcq subsystem shall measure data completeness. This shall distinguish between missing data (available but not received yet) and incomplete data (not available).

3.1.1.4 Data Buffering

RI3.1.1.4.a All components of the DAS which communicate with other components on a separate LAN shall provide data buffering which allows for a minimum of four hours of communications outage.

3.1.1.5 Assurance of Communications

RI3.1.1.5.a All communications protocols shall require confirmation of receipt of its messages prior to removing messages, or at least the data being sent, from buffers.

RI3.1.1.5.b All communications protocols shall require confirmation of completeness of message content prior to removing messages.

3.1.1.6 Unclassified unprocessed waveform archive

3.1.1.6.1 Storage Classes

RI3.1.1.6.1.a The UDAS shall continue to store all unprocessed waveform data it receives. Currently available capacity allows these data to be retained for a minimum of 180 days. Data will be stored in separate classes, although data can overlap classes. The classes based on the age of the data are as follows:

- **Short-Term Storage** - all data less than five days old.
- **Intermediate-Term Storage** - all data between five and ten days old.
- **Long-Term DLT Archive Library (near-line storage)** - all data more than ten days old up to the capacity of the storage device (minimum of 180 days).

3.1.1.6.2 Long-Term Data Access

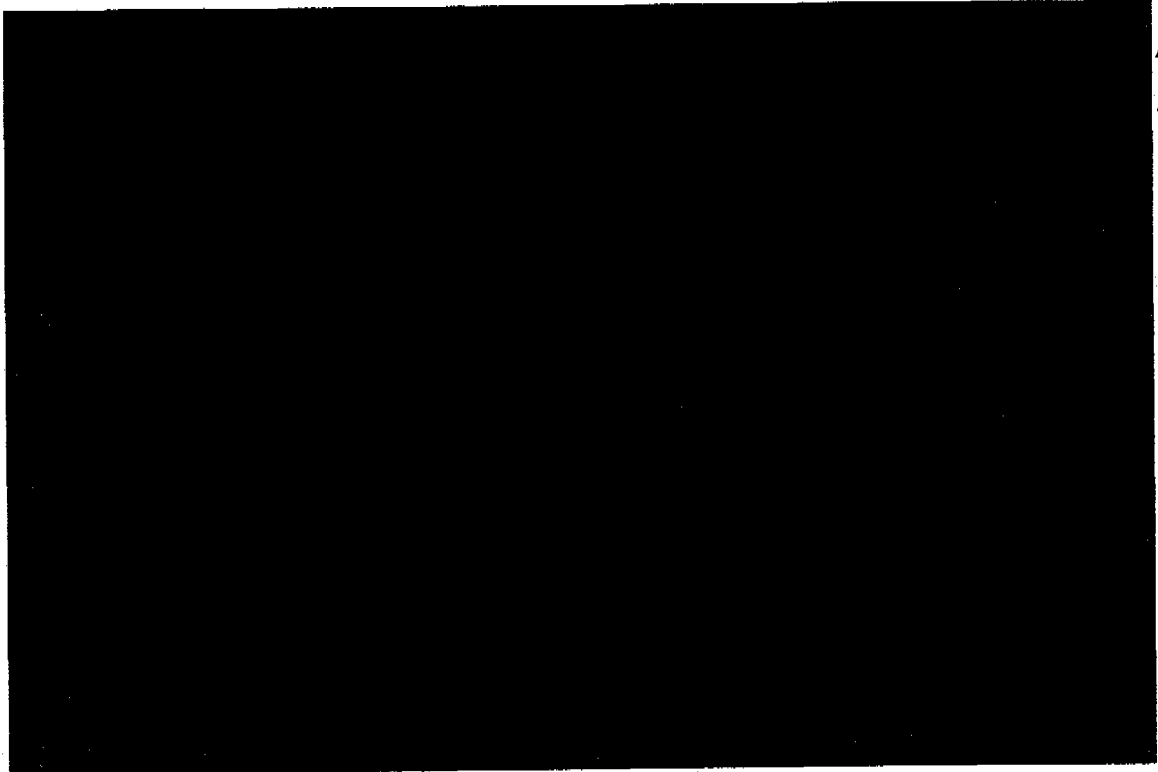
RI3.1.1.6.2.a Data in long-term storage shall continue to be accessible with a latency of 60 minutes.

3.1.1.6.3 Archive Requirements

RI3.1.1.6.3.a All unprocessed waveform data received from all sources will continue to be archived after conversion into CSS 3.0 "wfdisc" and ".w" files for a minimum of 180 days.

3.1.1.6.4 Transition of Storage

RI3.1.1.6.4.a When data are transitioned from one storage medium to the next, the data on the sourcing system shall not be removed without confirmation that the target storage device has fully and reliably received the data.



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3.1.2.2 Storage of Data

RI3.1.2.2.a [REDACTED] store all data it receives, and shall assure that these data are not corrupted or lost in any way. Data shall be stored in separate classes, although data can overlap classes. The classes based on the age of the data are: AF b(2) AF b(3)

- Short-Term - data less than ten days old
- Long-Term waveform data - all data more than ten days old up to 45 days old
- Long-Term alphanumeric data - all data more than ten days old up to one year old
- Archive of waveform data - data older than 45 days
- Archive of alphanumeric data - data older than one year

RI3.1.2.2.b Long-Term and Archived Data Access. Data in long-term storage shall be accessible to other subsystems/processes with a latency of less than 24 hours.

RI3.1.2.2.c Archive Requirements: All data (full period waveforms and waveform segments) from all sources shall be archived.

RI3.1.2.2.c.1 All archived data shall be able to be retrieved from the archives and restored to an on-line platform.

RI3.1.2.2.d Transition of Storage. When data are transitioned from one storage medium to the next, the data on the sourcing system shall not be removed without confirmation that the target storage device has fully and reliably received the data.

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[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

3.2 Data Management System (DMS)

The Phase 1 US NDC requires a DMS capable of supporting increasing amounts of data as the system expands. Practically, the DMS is anticipated to be a very large Oracle database system. While unprocessed data for the Phase 1 US NDC is technically under the control of the DMS, for the purposes of requirements, the control of unprocessed data is covered by the DAS.

3.2.1 Capability

RI3.2.1.a General. Any data removed from the on-line database shall be retained, and shall be able to be restored within 24 hours of notification.

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[REDACTED]

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3.2.2 Archive Requirements

RI3.2.2.a All data shall be archived.

3.2.3 Responsiveness

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3.2.4 Reliability/Availability

 The DMS must be highly available, which can be achieved by either a very responsive repair time of less than eight hours or high availability hardware. AF b(2)

RI3.2.4.a Database backups shall be performed on a regular, continuous basis without causing any interruptions to US NDC operations.

RI3.2.4.b A record of all database transactions which impact the data (i.e., update, delete, insert, etc.) shall be continuously updated and periodically archived. In the event of a database failure, the backup can be used to reconstruct those transactions in the database, and restore the database to any user-specified point in the archives.

RI3.2.4.c Upon any single failure, the DMS shall not permanently lose (wfdisc) data.

3.3 Data Services

There are no requirements for the Phase 1 US NDC to supply data to the US community at large.

3.4 Waveform (Seismic and Hydroacoustic) Processing Requirements

3.4.1 General Requirements

RI3.4.1.a All software functions, unless explicitly excepted here, shall have the capability to be initiated by a user outside of the automated processing pipeline. Mechanisms for initiation of routines shall include, but not be limited to, Graphical User Interfaces (GUIs), UNIX shell scripts, and command line/parameter file execution.

RI3.4.1.b The system shall interact with a central database management system (DMS).

RI3.4.1.c The US NDC Waveform Processing System (WPS) shall have the capability to recalculate derived alphanumeric computations, measurements, etc., store these values, and retrieve them from the DMS for access by various pipeline processes and users.

3.4.2 Hydroacoustic General Requirements

RI3.4.2.a The Phase 1 US NDC shall perform signal detections on all available hydroacoustic data.

RI3.4.2.b The Phase 1 US NDC shall make signal detection data available to all other automated processes.

RI3.4.2.c All hydroacoustic waveform and alphanumeric data shall be available to the analysts and TT personnel.

3.4.3 System Capacity (Event Load Requirements)

The processing system must process data under various event loading scenarios.

3.4.3.1 Normal loading

[REDACTED]

3.4.3.2 Swarm loading

[REDACTED]

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3.4.4 Waveform Processing System Modes

The WPS must process data in the Global, Look-Forward, Look-back/Recall, Spotlight, and Broad Area Regional Modes of operation.

3.4.4.1 Global Processing Mode (GPM). This mode, the core of the operational system, covers processing of all waveform data from data acquisition to reporting.

RI3.4.4.1.a Teleseismic GPM shall be performed on all data from stations listed in Tables 1A and 2.

RI3.4.4.1.b Teleseismic GPM shall be performed on all data from those stations listed in the Network Definition Document for the United States National Data Center through 1 February 2003. (Phase 1 Upgrade)

3.4.4.2 Look-Forward Mode



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RI3.4.4.2.a Look-Forward Processing shall operate on selected areas of interest on an as-needed basis.

RI3.4.4.2.b The system shall be capable of processing six selected areas at any given time. (Phase 1 Upgrade)

RI3.4.4.2.c Selected unprocessed waveform data shall be available to the analyst within 60 seconds of arrival at the DAS.

RI3.4.4.2.d Look-Forward processing results shall be available for initial reporting purposes within ten minutes of the data becoming available.



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3.4.4.3 Look-back/Recall Mode

This mode is designed to re-process data in an off-line mode. This processing mode would be instituted on an as-needed basis whenever outside information indicates a possible nuclear explosion has occurred. Based on this outside information, additional processing would be performed on a limited geographic area and time interval in order to perform more thorough processing than that previously obtained.

RI3.4.4.3a The system shall provide the capability to process data from a limited time interval and geographic region as defined by the user.

RI3.4.4.3.b The system shall have the flexibility to manually customize Look-Back processing on a case-by-case basis in order to meet varying requirements of each look-back inquiry.

RI3.4.4.3.c The system shall provide the capability to process one Look-Back data set at a time.

RI3.4.4.3.d The system shall provide separate database accounts and disk space for Look-Back processing (the maximum shall be six two-week data sets composed of the US NDC GPM station network) .

RI3.4.4.3.e Look-Back processing results shall be made available to the analyst immediately.

3.4.4.4 Spotlight Mode

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RI3.4.4.4.a Spotlight Processing shall be capable of operating routinely and continuously on selected areas of interest at all times.

RI3.4.4.4.b This system shall process up to eight selected areas at any given time.
(Phase 1 Upgrade)

RI3.4.4.4.c The system shall have the flexibility to customize spotlight processing on a case-by-case basis in order to meet varying requirements of each region.

3.4.4.5 Broad Area Regional Processing Mode

This processing mode is designed to automatically and continuously process selected data at selected detection and discrimination thresholds below the GPM thresholds within user-specified broad regional areas, using data from both teleseismic and regional stations. The US NDC shall integrate the capability, to be provided as GFE, to incorporate regional travel-time curves and travel-time correction surfaces in detailed analysis.

RI3.4.4.5.a Broad Area Regional Processing shall be capable of operating routinely and continuously on a selected region of interest at all times. (Phase 1 Upgrade)

RI3.4.4.5.b

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RI3.4.4.5.c The US NDC shall have the capability to configure the data processing and parameters of the selected area of interest. (Phase 1 Upgrade)

RI3.4.4.5.d The US NDC shall provide BARPM processing results within sixty minutes of the data becoming available. (Phase 1 Upgrade)

3.4.5 Other Functionality

3.4.5.1 Sustainment System

This is a functional duplication of the WPS hardware and software configuration with access to all unprocessed data, and is designed to provide a facility for timely testing of new algorithms, hardware configurations, etc., without impacting routine operations.

[REDACTED]

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RI3.4.5.1.b This system shall duplicate a subset of the DAS, to include, at a minimum, a secure diode, a diskloop machine, and a database instance.

RI3.4.5.1.c All operational parameter and recipe files shall be duplicated so that modifications can be made without impacting the operational system.

RI3.4.5.1.d The processing results shall remain completely separate from the operational system.

RI3.4.5.1.e All data, including archived and real-time, available in the operational system shall be accessible in the read-only mode.

3.4.5.2 Late-Arriving Data

RI3.4.5.2.a Late-arriving data shall be available to the analyst within five minutes after receipt [REDACTED] Notification to the SOM is necessary.

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RI3.4.5.2.b Late-arriving data shall be sent through automatic operational processing for incorporation into regularly scheduled products.

3.4.6 Signal Detection

RI3.4.6.a This stage shall have the capability to pre-process unprocessed data prior to signal detection. Pre-processed data includes pre-filtering data prior to beam forming (essential for LP arrays which have one BB site); configuration of beam parameters,

recipe files, and filters; permit conditioning of the waveform to include removal (a filter) of system transfer function; and conditioning of the waveform to include filtering for passbands of interest.

RI3.4.6.b The system shall form radial and transverse beams for three-component data.

RI3.4.6.c The system shall automatically form beams from array data.

RI3.4.6.d The system shall run detection algorithms over seismic and hydroacoustic waveform data.

3.4.7 Signal Measurement

RI3.4.7.a The system shall have the capability to retrieve unprocessed data before measurements.

RI3.4.7.b The system shall automatically compute time-domain measurements, including attributes such as onset time, period, amplitude, and polarization.

RI3.4.7.c The system shall compute frequency-domain measurements, including attributes such as frequency content and power.

RI3.4.7.d The system shall compute wavenumber measurements, including attributes such as wavenumber, amplitude, and associated statistics.

3.4.8 Signal Identification

The capability shall exist to identify all relevant phases for each technique listed below.

Hydroacoustic:

RI3.4.8.a The system shall identify the direct hydroacoustic phase and the converted tertiary (T) phase.

Seismic:

RI3.4.8.b The system shall identify teleseismic phases.

RI3.4.8.c The system shall make initial phase identifications based on available signal characteristics.

RI3.4.8.d The system shall modify phase identifications after association to an event.

3.4.9 Signal Association

RI3.4.9.a For the seismic technique, the system shall perform station-level phase grouping; i.e., to group phases from a single station that belong to the same event.

RI3.4.9.b For the seismic technique, the system shall perform network-level phase grouping; i.e., to group phases from multiple stations that belong to the same event within a single technique.

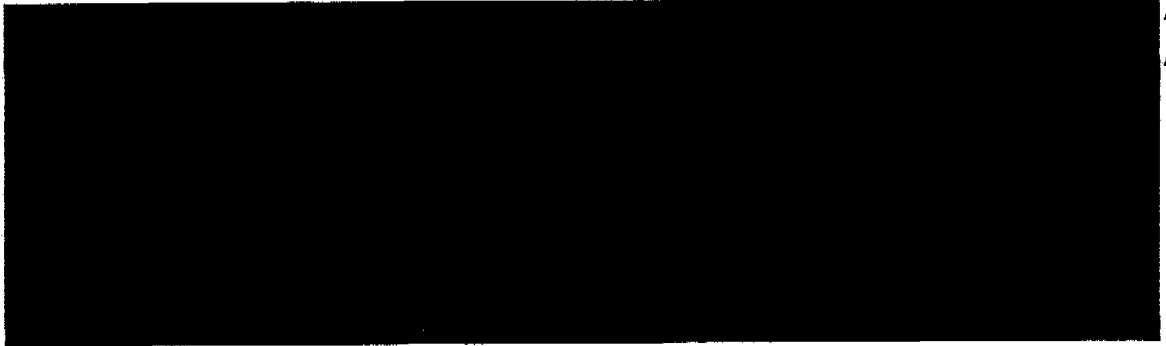
RI3.4.9.c For the seismic technique, the system shall provide the capability to associate data at various stages in the processing system (necessary for late-arriving data).

3.4.10 Event Location



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3.4.11 Source Characterization



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3.4.12 Interactive Analysis Capability

The purpose of Interactive Analysis is to provide the user with the capability to review, refine, correct, and/or display the currently available results, regardless of whether they have been generated directly from the automated processing system or from previous analysis by another user.

3.4.12.1 General Requirements

RI3.4.12.1.a The system shall permit the display and manipulation of all available seismic and hydroacoustic waveform data.



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RI3.4.12.1.c The capability shall exist to display and manipulate each waveform data type individually by technique.

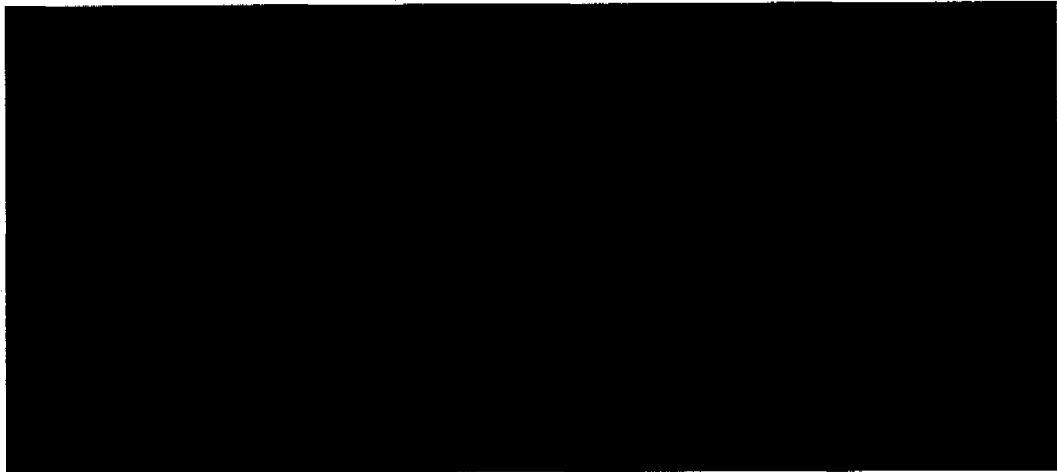
RI3.4.12.1.d The capability shall exist to review the results of any and all data available at any stage of the automated processing system.

RI3.4.12.1.e The capability shall exist to review, modify, and save the old and new results of each analyzed event.

RI3.4.12.1.f The system shall have the capability to auto-save results which are called up for analysis until a new solution is saved by the user.

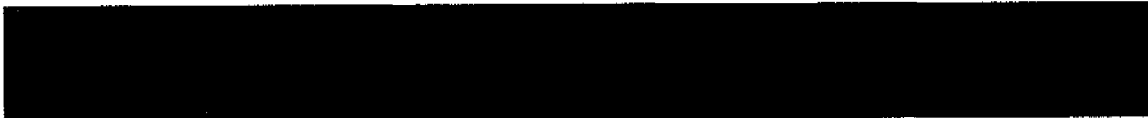
RI3.4.12.1.g The user shall be able to graphically compare results from any processing stage with the unprocessed data. For example, the user can pull up results from any stage in processing (e.g., after detection processing, after association processing, after first analyst, etc.).

RI3.4.12.1.h The user shall have the full range of analysis capabilities available for processing. The analysis capabilities include the following:



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RI3.4.12.1.j The user shall have the capability to include additional data in the analysis as it becomes available. These additional data shall include, but are not limited to, waveforms, arrival time picks (when waveforms are not available), etc.

RI3.4.12.1.k The user shall have the capability to graphically examine event information in conjunction with various Knowledge Base (KB) spatial data layers (e.g., topography, areas of interest, seismicity catalogs).

RI3.4.12.1.l The user shall have the capability to display waveforms from one or more events from an on-line database.

3.4.12.2 Detailed Analysis (DA). In addition to the general requirements listed above (3.4.12.1), the following specific functions shall be available for events during DA:

RI3.4.12.2.a Signal Processing Interface. For existing detections (either manually added or produced by automated processing), the capability shall exist for the user to invoke the same algorithms as those used in automated processing for measurement of detection features.

RI3.4.12.2.b Automatic Association Interface. For existing events (either manually added or produced by automated processing), the capability shall exist for the user to

invoke the same association algorithms as those used in automated processing for associating additional arrivals to the event.

RI3.4.12.2.c Discrimination Interface. The capability shall exist to review and modify processing event identification results, including teleseismic and hydroacoustic discriminants.

RI3.4.12.2.d DA shall not interfere with ongoing routine processing of other events.

3.4.12.3 Event Identification

RI3.4.12.3.a Event Identification shall place a given event in one of several categories, including "probable earthquake," "probable explosion," and "unidentified."

RI3.4.12.3.b For each event for which an identification is obtained, a degree of confidence in that event identification shall be assigned (e.g., high confidence, probable).

RI3.4.12.3.c Each event shall be tagged as "Area of Interest" or "Outside Area of Interest," based upon event location.

3.4.12.4 Geographical Information

RI3.4.12.4.a The US NDC shall integrate software tools and functions, to be provided as GFE, which allow interactive access, spatial manipulation, and spatial processing of geographically referenced data. (Phase 1 Upgrade)

RI3.4.12.4.b The US NDC shall integrate the capability, to be provided as GFE, to store, manage, maintain, and analyze information with spatial relationships, including points, lines, polygons, imagery, and metadata. (Phase 1 Upgrade)

RI3.4.12.4.c The US NDC shall integrate the capability, to be provided as GFE, to generate high quality graphical and tabular presentations of the results of spatial processing of geographically referenced data. (Phase 1 Upgrade)

3.4.13 Derived Data

3.4.13.1 Creation of Seismic Beams

The requirements in this section are geared towards array stations in which a "beam" refers to the derived waveform generated from beamforming of the array elements.

RI3.4.13.1.a The capability shall exist to automatically generate detection beams, from frequency and wave number (fk) processing, for all array sensor stations in the network.

RI3.4.13.1.b The capability shall exist to automatically generate origin beams, in the predicted arrival time window, and steered to an event, for array sensor stations that do not have associated detections.

RI3.4.13.1.c Any automatically generated derived data (i.e., event beams) shall be made available for analyst review.

RI3.4.13.1.d The capability shall exist for the user to generate fk beams and event beams during interactive analysis.

RI3.4.13.1.e The user shall have the capability to specify the default beam direction (i.e., azimuth and slowness) so that a generated fk beam can be directed to a user-selected location in fk space.

RI3.4.13.1.f All derived data (beams) and beam parameters shall be available on-line for a period of at least 45 days.

RI3.4.13.1.g Beam parameters shall be allowed to vary based on configurable criteria. These criteria shall include, but not be limited to, input channels, phase-ID, length or duration, start time (prior to a specific phase), end time (after a specific phase), the number and type of beams. Some examples of possible beam types include fk vs. event beams; teleseismic vs. regional; long-period vs. short-period.

3.5 Radionuclide System: No requirements for Phase 1 US NDC

3.6 Reporting Requirements

[REDACTED]

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3.6.1 Bulletin Products

RI3.6.1.a Single Technique Bulletins shall consist of results from any single technique (i.e., seismic, hydroacoustic, etc.). Data for each of the techniques will be available at different times following an event due both to the physical nature of the propagation media and the time necessary to process the unprocessed data. A bulletin shall be produced at the conclusion of a process or at a specific time by interactive selection.

RI3.6.1.b Seismic bulletins shall include, but not be limited to, basic event (i.e., latitude, longitude, time, depth, size) and station phase arrival (i.e., phase type, sensor, time, size) information.

RI3.6.1.c Hydroacoustic bulletins shall include, but not be limited to, station phase arrival (phase type, time, size) information.

RI3.6.1.d The capability to automatically compare two bulletins to identify common events and to characterize their differences (e.g., location, depth, associations, etc.) shall be provided.

RI3.6.1.e The capability to compare bulletins based on event information only, or on event and arrival information, shall be provided.

3.6.2 Event Driven Processing (All)



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3.7 Research Support

In-house researchers have the responsibility for special event analysis, to verify the Phase 1 US NDC performs as designed, to improve its capability by adding new knowledge and data, and to suggest enhancements that improve its capability.

RI3.7.a Researcher workstations shall have access (read and execute) to DEVL, TEST, and OPS executables, par and recipe files, and documentation for use and execution on the TT LAN.

RI3.7.b Researcher workstations shall have read-only access to current on-line data, archived data, and database accounts without adverse impacts to DEVL, TEST, or, OPS.

RI3.7.c Researchers shall be provided the capability to access (read-only) source code for each level (DEV, TEST, OPS). As currently designed, this requires operating under ClearCase.

RI3.7.d Researchers shall be provided the capability to check out code following Configuration Management practices, for R&D efforts, and to operate in a DEVL environment with no impact on other DEVL users. In practice, this may be achieved by providing researchers remote log in capability to a DEVL workstation on which ClearCase runs.

3.8 Distributed Applications Control System (DACS)

The Phase 1 US NDC requires an automated processing system capable of supporting very large volumes of continuously acquired data. To support this capability, a DACS is anticipated to perform this computing. The DACS must be highly reliable and capable of being easily operated and monitored while it controls a complex sequence of processing tasks.

Scope: The DACS is defined, for the purposes of these requirements, as the software needed to control execution of all other applications within the automatic and interactive processing of the Phase 1 US NDC. The DACS fulfills two primary functions; it facilitates communication between applications and provides process control and monitoring for the computer system. It supports operation of the specific applications of the Phase 1 US NDC, but does not include support routine tasks required by complex computing systems, such as system administration and database administration. [REDACTED] AF b(2)
[REDACTED] AF b(3)

3.8.1 Processing Control

RI3.8.1.a Operator Started Tasks. An operator shall be capable of starting any task on the system from a control interface.

RI3.8.1.b Operator Stopped Tasks. An operator shall be capable of stopping any task on the system from a control interface.

RI3.8.1.c Automatically Started Tasks. The DACS shall be capable of automatically initiating processing based on configurable criteria. These criteria shall include, as a minimum, time, availability of data from the Data Acquisition System (new data entries), and completion of prior processing steps (i.e., all detection processing complete for a given time).

RI3.8.1.d Sequence Processes. The DACS shall control the sequencing of multiple processes so that dependent processes are executed in sequential or parallel paths. These sequences shall be configurable, and the DACS shall support rules-based processing of sequential tasks such that the success or failure of one task can initiate another task.

3.8.2 Processing Monitor

RI3.8.2.a Process Status. The DACS shall notify an operator of the failure of any individual process under DACS control (i.e., abnormal termination). Current status shall be given for all processes in execution.

RI3.8.2.b Process State. The DACS shall inform the operator of the state of all automatic sequencing tasks.

RI3.8.2.c Process Logs. The DACS shall provide for the operator a consistent interface to all logs of system applications.

3.8.3 Reliability/Availability

RI3.8.3.a Loss of a Single Computer. The DACS shall report the loss of a pipeline computer.

3.8.4 Security

RI3.8.4.a Unauthorized Requests for Service. Only authorized users shall be allowed to initiate processing. Unauthorized requests shall be rejected and logged. (Because of the distributed nature of the DACS, messages to start and control processes must be authenticated to ensure the requester for the service is authorized.)

3.9 Data Processing Performance Monitoring

The purpose of Data Processing Performance Monitoring is twofold: to provide a method to monitor components of the Phase 1 US NDC data processing system, and to quantify the level of performance. This functionality will allow users of the system to observe changes in performance as components of the system change (i.e., new versions of data processing software, addition of stations or techniques, new processing algorithms, etc.). It will allow for comparison of processing results within the Phase 1 US NDC data processing system (i.e., automated vs. interactive processing results) and between processing systems (i.e., US NDC vs. ADSN). It will also provide the baseline knowledge necessary to implement incremental improvements in the data processing system. The foundation of the Data Processing Performance Monitoring system will be the collection of appropriate data and the statistical analysis and interpretation of results based on these data. For simplicity, this functionality is referred to in this and other documents by the term 'Performance Monitoring (PM)'. The above functions are performed manually on the current operational system. The prototype "Perfmon" for evaluating LDEs is superior to the ADSN version. This version of "PerfMon" is required for the Phase 1 US NDC.

3.9.1 General Requirements

RI3.9.1.a The system shall monitor and quantify performance of various software components within the data processing system.

RI3.9.1.b The system shall routinely monitor the continuous automated data processing pipeline.

RI3.9.1.c The capability shall exist for user-generated PM investigations of any component of the data processing pipeline.

RI3.9.1.d The PM software shall have the capability to be run automatically and at regular intervals.

RI3.9.1.e Interactive viewing of automatically generated PM results shall be available for the Phase 1 US NDC.

RI3.9.1.f The capability shall exist to monitor the effect on the performance of the data processing pipeline and its components due to changes in versions of the following:

- software components and their parameter files
- static information (i.e., travel-time tables)
- overall system configurations (operating system, database, etc.)

RI3.9.1.g The system shall perform extensive and systematic statistical comparisons between the intermediate processing results and final analysis results of this system with those of other operational systems (such as the IDC in an off-line mode). At a minimum, the types and quantities of data available for review are listed in Table 4. For reference, wherever appropriate, current database accounts which contain these results are also listed.

RI3.9.1.h The capability shall exist to compare current observations to historical averages of station detection rates.

Process or Function	System	Current Database Account	Quantity of Data Available
automatic detection	*ADSN	*DETPRO	*Most recent 90 days
automatic association and location	*ADSN	*SOCCPRO	*Most recent year
reviewed event bulletins/analysis and evaluation results	IDC	IDCREB	Most recent year
		AL1@midterm	Most recent year (<45 days)
	*ADSN	*AL2@longterm	*Most recent year (<90 days)
supplementary event bulletins		EVAL1@longterm	Most recent year
	IDC	IDCGAMMA	Most recent 180 days

*ADSN accounts will be utilized through acceptance testing

Table 4: Data Available for Review

RI3.9.1.i A consistent graphical interface shall be used among performance monitoring tools.

RI3.9.1.j Figures produced by PM shall be available in on-line displays and/or hard copy.

RI3.9.1.k PM shall provide the capability to produce high quality output for review.

RI3.9.1.l The system shall have the capability to automatically generate periodic summary reports.

3.9.2 Data Acquisition: Waveform Processing

RI3.9.2.a The DataAcq subsystem shall track data availability at certain points in time.

RI3.9.2.b The DataAcq subsystem shall track the timeliness of the data by determining the latency time between data recording at the station and receipt in the DMS. This shall generally be performed on data intervals rather than on individual data packets.

RI3.9.2.c The DataAcq subsystem shall have the capability to monitor data quality parameters and information as recorded during the Data Control functions.

RI3.9.2.d The software shall have the capability to retrieve and process data quality information for PM purposes. For example, the PM shall be capable of extracting information about the percentage of masking at a given station and time interval and displaying this information in a statistical form.

4.0 RELIABILITY AND MAINTAINABILITY REQUIREMENTS

This section defines the reliability and maintainability requirements for the Phase 1 US NDC. Reliability covers the capability of the Phase 1 US NDC to continue to meet AFTAC's mission over its life-span, while maintainability covers the amount and type of support needed to meet reliability goals.

RI4.a The maintainability of the Phase 1 US NDC shall be evaluated based on a combination of experience during the development process, tests designed to assess the maintainability of the system, analyses based on prior experience, and expert judgment.

4.1 Reliability

4.1.1 Mission Duration

The mission duration of the Phase 1 US NDC system is defined as 24 hours.

4.1.2 System Lifetime

The Phase 1 US NDC will replace the ADSN processing system in the second quarter of FY 1998. The Phase 1 US NDC will be replaced by the US NDC in the second quarter of FY 1999.

4.1.3 System Critical Failure

A critical failure in the Phase 1 US NDC implies that a portion of the Phase 1 US NDC system is unable to collect or process the required data. The remaining portion of the network will continue to perform its mission requirements.

4.1.4 Mean Time Between Critical Failure (MTBCF)

[REDACTED]

4.1.5 Mean Restoral Time (MRT)

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The MRT is the time to restore the subsystem to an operational condition after a critical failure and includes notification, response, supply, administration, and maintenance.

[REDACTED]

4.1.6 Mean Time To Repair (MTTR)

RI4.1.6.a The MTTR is the actual time to repair a failure once the technician and spares are at the equipment. The MTTR of any subsystem shall be less than one hour.

[REDACTED]

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4.1.7 Operational Availability (A_0)

$$A_0 = \frac{MTBCF}{MTBCF + MRT}$$

[REDACTED]

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4.1.8 COTS Equipment

RI4.1.8.a The Phase 1 US NDC shall use Commercial-Off-The-Shelf (COTS) equipment, wherever possible.

5.0 SECURITY REQUIREMENTS

[REDACTED]

5.1 General

RI5.1.a Deleted, CCB, 17 Dec 99, SCN NDC-00-001

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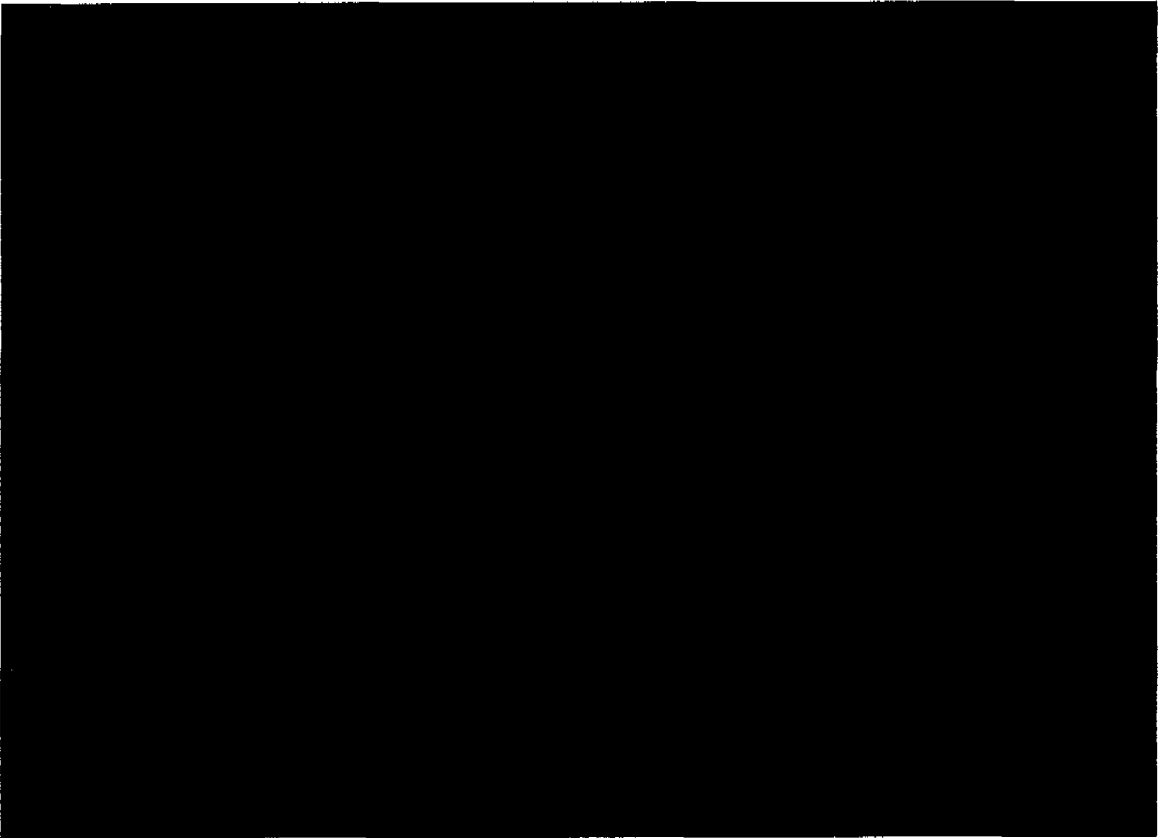
[REDACTED]

5.2 Security Mode of Operation



5.2.1 System High Security Mode Requirements

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6.0 PHYSICAL REQUIREMENTS

No physical requirements for the Phase 1 US NDC software development.

7.0 SOFTWARE REQUIREMENTS

This section defines the requirements for the software used in the Phase 1 US NDC system. Software for the Phase 1 US NDC shall make maximum use of standard commercially available off-the-shelf software.

7.1 Applications Software Environment

RI7.1.a The Phase 1 US NDC applications software shall operate in a Solaris 2.5.1 operating environment or higher.

The following AFTAC standard shall be used in the Phase 1 US NDC software:

RI7.1.b SQL [FIPS127] interface to the Oracle database management system.

7.2 Software Design and Implementation Requirements

7.2.1 Software Flexibility

The Phase 1 US NDC shall accommodate the following without disrupting normal operations:

RI7.2.1.a Missing seismic or SOH data.

RI7.2.1.b Additional field sites.

RI7.2.1.c Variations in the number of operating field sites.

RI7.2.1.d Variations in the background seismic noise at individual sensors and field sites.

RI7.2.1.e Variations in the quantity and timing of data received over the wide-area communications system.

RI7.2.1.f Variations in the timing of the receipt of unprocessed waveform data on transportable media.

7.3 Software Traceability

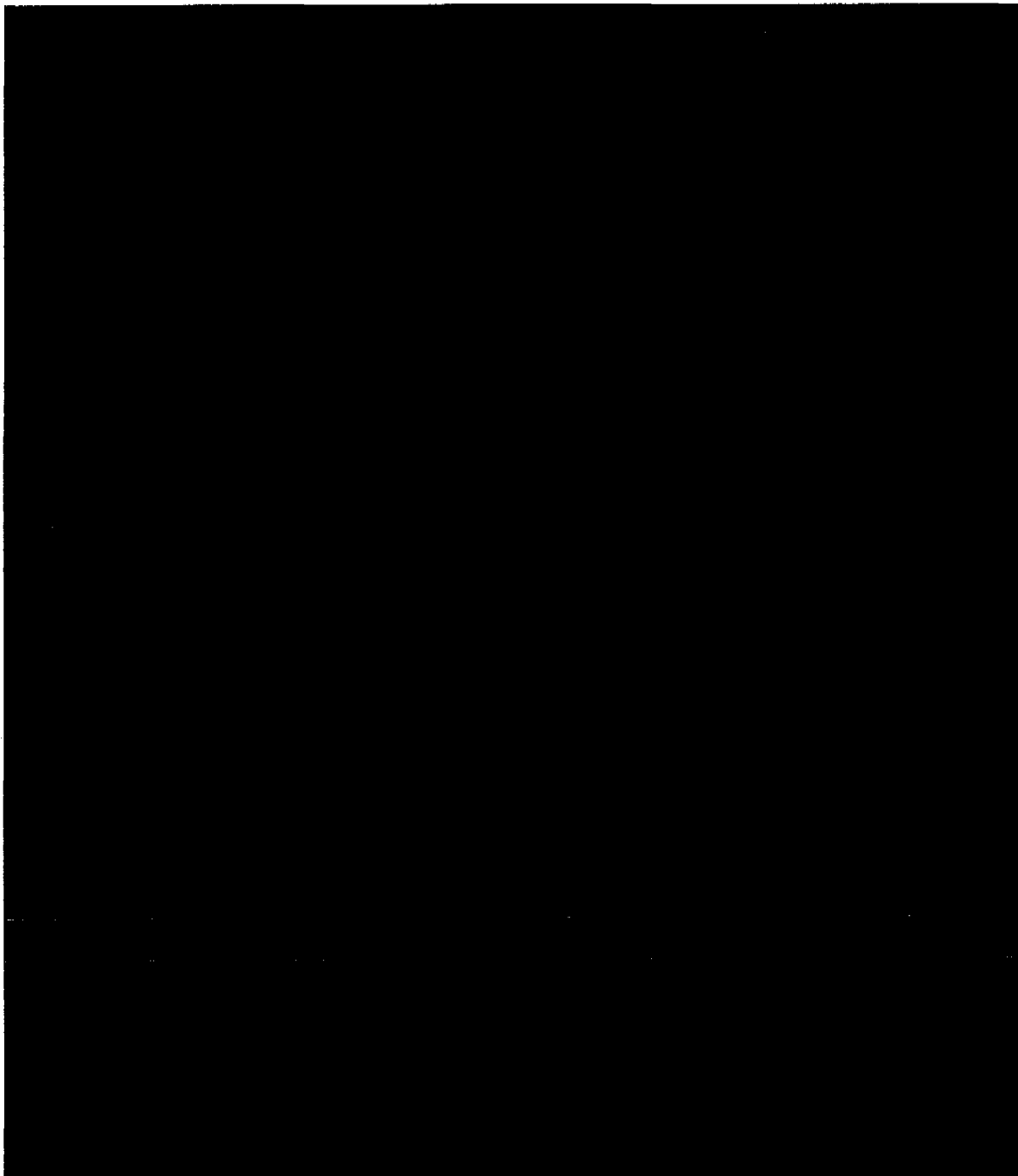
RI7.3.a The applications software for the Phase 1 US NDC shall have the capability necessary to generate detailed change histories for software modifications.

RI7.3.b This mechanism shall, at a minimum, include the capability to log code modifications, code deletions, code additions, and code replacements.

RI7.3.c An auditable Configuration Control Board (CCB) process and Change Request (CR) process shall be established and followed.

RI7.3.d The capability shall exist to "undo" changes made during the software maintenance activity, returning the software to any given previous state.

8.0 HUMAN FACTORS REQUIREMENTS



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8.3 *Training Requirements*

This section describes the training requirements that are considered an integral part of the Phase 1 US NDC system.

8.3.1 Initial User Training

The following are minimum requirements for the initial on-the-job training (OJT) program:

RI8.3.1.a The training program shall show the operator how to identify basic system malfunctions and how to take necessary corrective actions.

RI8.3.1.b The training shall include hands-on use of the Phase 1 US NDC workstation, system, and applications software.

RI8.3.1.c The training program shall include system administration and database administration introductory training.

9.0 YEAR 2000 (Y2K) REQUIREMENTS

RI9.0.a The US NDC system shall correctly process data across the Millennium (Year 2000) boundary.

RI9.0.b The US NDC system shall correctly recognize and process Year 2000 as a leap year.

RI9.0.c The US NDC system shall correctly manipulate dates and date fields in a clear and unambiguous manner.

RI9.0.d The US NDC system shall correctly process dates within data acquired from external sources.

10.0 Appendix A: Definitions

ADSN - AFTAC Distributed Subsurface Network

AFTAC - Air Force Technical Applications Center

Alphanumeric data - All ASCII data including parametric data, requests, and calibrations

ASN - AFTAC Southern Network

Beamforming - The process of shifting and adding the recorded waveforms. This process cancels out noise and aligns major signals to remove propagation delays in the seismic array.

[REDACTED]

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CCB - Configuration Control Board

Channel - Refers to output from an individual sensor

Classify event - To determine if an event is an earthquake or an explosion

COTS (Commercial Off-The-Shelf) - Refers to commercially available hardware and software that has not been locally modified

Critical failure - When a portion of the system is unable to collect or process the required data

CTBT - Comprehensive Test Ban Treaty

DAA - Designated Approving Authority - Official with the authority to formally assume responsibility for operating a computer system or network at an acceptable level of risk

DAC - Discretionary Access Control - Means of restricting access to objects (files and programs) based on the identity and need-to-know of users and/or groups to which the object belongs

DACS - Distributed Applications Control System - Software needed to control execution of all other applications within the automatic and interactive processing of the Phase 1 US NDC

DAS (Data Acquisition System) - Acquires and distributes near-real-time data from a global network of sensors

Det - Short for detachment, an AFTAC location with AFTAC personnel and equipment.

DMS (Data Management System) - The software needed to manage the data acquired and generated by the Phase 1 US NDC

DMZ - The area between the firewall and the router

EL - An "equipment location" where there is AFTAC equipment but no AFTAC personnel

Field site - Used in many different ways, can be a single sensor location (see the definition for site), a station or array location, or a single Det or EL or a group of Dets/ELs (grouped for communications reasons). [REDACTED] AF b(2)
[REDACTED]

fk analysis - Spectral analysis in the frequency and wave number domain

Full period data - Continuous data

ICS - Intrasite Communications Subsystem

IMS - International Monitoring System

Phase 1 US NDC - Subsurface Operating System to be used by HQ AFTAC beginning in the second quarter of FY 98

LAN (Local Area Network) - A hardware/software system for linking computers, storage devices, and graphics devices over a relatively small geographic area (e.g., a building).

Late arriving data - Data that arrive after initial automatic processing of the time interval was begun or up to six months behind real-time

LP (Long Period) data - Falls in the .01 - 0.5 Hz range

LRU - Line Replaceable Unit

MRT (Mean Restoral Time) - The time to restore a system to operational condition after a critical failure

MTBCF - Mean Time Between Critical Failures

MTTR (Mean Time To Repair) - The actual time to repair a failure once a technician and spares are at the equipment

"O" technique - Hydroacoustic technique consisting of unattended field sites used for monitoring nuclear explosions

Parametric data - Information on detection picks such as time, amplitude, period, etc.

PIDC - Prototype International Data Center

RT (Remote Terminal at some USAEDS sites) - Located at the top of the borehole, the RT filters analog data from the seismometer, converts the data from analog to digital and sends it on to the central terminal. The RT also allows for calibration of the seismometer.

Sensor(s) - Equipment needed to record seismic signals. Typically, sensor includes the seismometer, remote terminals, and the intrasite communications.

Site - A single sensor location (e.g., a borehole) or a vault containing several sensors (same latitude/longitude coordinates) or the center of an array of sensors. This term is also used to refer to a station or an array.

SOH - State-of-Health data

SP (Short Period) data - Falls in the 0.5 - 10 Hz range

SPR - Software Problem Report

SQL (Structured Query Language) - A language used to access relational databases

SSS - Sensor subsystem

Station - A relatively small geographical area where there can be a number of seismic sensors (possibly including an array). Stations are usually designated by a one to four character name, such as FX and CBAR.

System High Mode or System High Security Mode - Computer system security mode of operation where each user with direct or indirect access to the system, its peripherals, remote terminal, or remote hosts has all the following: (1) Valid security clearance for all information within the system. (2). Formal access approval and signed non-disclosure agreements for all the information stored and/or processed (including all compartments and/or special access programs). (3). Valid need-to-know for some of the information contained within the system.

TT - The AFTAC Nuclear Treaty Monitoring Directorate

UDAS - Unclassified Data Acquisition System

Unprocessed data - Continuous waveform data as received at HQ AFTAC

USAEDS (United States Atomic Energy Detection System) - The conglomeration of nuclear testing monitoring techniques. These techniques are each designed to monitor a specific physical domain (e.g., space, atmosphere, underground, oceans, etc.) for nuclear explosions.

USGS - United States Geological Survey

Waveform segment - A limited window of a seismic signal

Wide Area Network (WAN) - Computer network that services a large area. WANs typically span large areas (i.e., states, countries, continents) and are owned by multiple organizations.

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27 Oct 00

Appendix B: US NDC Phase 1 Upgrade Performance Requirements

1.0 Scope

This appendix contains system-level requirements for the upgrade to the Phase 1 US NDC System which are traceable to the Phase 1 US NDC System Requirements Document (SRD). This appendix constitutes the change pages for a specification change notice (SCN) to the Phase 1 SRD.

2.0 Referenced Documents

- Phase 1 US NDC SRD, Version 1.3, Document 1000607
- United States National Data Center Network Definition Document (NDDOC), 22 October 1999

3.0 Requirements

The section contains specifications for the upgrade of the US NDC Phase 1 system.

3.1 *Required states and modes*

The section does not apply.

3.2 *System capability requirements*

3.2.1 Broad Area Regional Monitoring (BARM) general capabilities

This section defines the general capabilities of the Broad Area Regional processing Mode.

3.2.1.1 Broad Area Regional Processing

[REDACTED]

3.2.1.2 Scope of BARM region

[REDACTED]

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AF b(3)

3.2.1.3 BARM network

[REDACTED]

3.2.1.4 BARM event detection threshold

The BARM shall achieve a lower event detection threshold than the GPM for events located in the BARM region.

3.2.1.5 Availability of BARM results

The results of BARM processing shall be made available for analysis within sixty (60) minutes of the data being available.

3.2.1.6 BARM automatic bulletin

The BARM shall automatically generate a continuous event bulletin containing events located in the BARM region.

3.2.1.7 BARM final bulletin

[REDACTED]

AF b(2)

AF b(3)

3.2.2 BARM processing capabilities

3.2.2.1 BARM signal detection

The BARM shall detect regional seismic and teleseismic signals associated with events located in the BARM region.

3.2.2.2 BARM detection features

The BARM processing shall measure the same detection features as the GPM.

3.2.2.3 BARM initial phase grouping

The BARM processing shall group phases detected at a station that emanate from a common source.

3.2.2.4 BARM initial regional phase identification

The BARM processing shall identify regional seismic phases within initial phase groupings.

3.2.2.5 BARM initial teleseismic phase identification

The BARM processing shall identify teleseismic primary arrivals within initial phase groupings.

3.2.2.6 BARM network phase grouping

The BARM processing shall group phases from all stations emanating from a common event.

3.2.2.7 BARM network phase identification

The BARM network processing shall have the capability to identify seismic phases superseding initial phase identification.

3.2.2.8 BARM restricted network processing search

The BARM shall only consider event hypotheses located in the BARM region.

3.2.2.9 Automatic BARM location

The BARM processing shall automatically locate events using teleseismic primary and regional seismic phases.

3.2.2.10 BARM regional travel-time tables

[REDACTED]

AF b(2)

AF b(3)

3.2.2.11 BARM m_b magnitude

The BARM processing shall compute m_b .

3.2.2.12 BARM regional magnitude

The BARM processing shall have the capability to compute regional magnitudes.

3.2.2.13 BARM detection beams

The BARM processing shall generate detection beams for all P-wave type arrivals.

3.2.2.14 BARM origin beams

[REDACTED]

3.2.2.15 Analyst access to regional travel-time tables

[REDACTED]

3.2.2.16 Configurability of BARM

[REDACTED]

AF b(2)

AF b(3)

3.2.3.1 BARM signal detection performance monitoring

[REDACTED]

3.2.3.2 BARM feature extraction performance monitoring

[REDACTED]

3.2.3.3 BARM regional phase identification performance monitoring

[REDACTED]

3.2.3.4 BARM automatic association performance monitoring

[REDACTED]

3.2.3.5 BARM interactive analysis performance monitoring

[REDACTED]

3.2.3.6 BARM bulletin comparison

[REDACTED]

3.2.4 Capabilities related to DoE products

AF b(2)

3.2.4.1 Support for existing location capabilities

AF b(3)

[REDACTED]

3.2.4.2 Application of DOE travel-time correction surfaces

The US NDC shall provide the capability to apply travel-time corrections specified by the DOE-provided travel-time correction surfaces for location and travel-time prediction.

3.2.4.3 GIS display of analysis origins and arrivals

The US NDC classified subsystem shall provide the capability to send origins and arrivals to the DOE GIS during evaluation.

3.2.5 Expansion of current Phase 1 capabilities

3.2.5.1 Unclassified waveform data acquisition storage

The UDAS shall store all waveform data received from external sources.

[REDACTED]

3.2.5.3 Simultaneous spotlight processing

[REDACTED]

AF b(2)

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3.2.5.4 Simultaneous look-forward processing

[REDACTED]

3.2.5.5 Look-forward processing station selection flexibility

[REDACTED]

3.2.5.6 Station capacity for teleseismic global processing

[REDACTED]

3.2.5.7 Station capacity for hydroacoustic processing

[REDACTED]

3.3 System external interface requirements

AF b(2)

3.3.1 DoE location interface

AF b(3)

3.3.1.1 Interface to DOE travel-time correction library

[REDACTED]

3.3.1.2 Access to DOE correction surfaces

[REDACTED]

3.3.1.3 Analyst interface to location options

[REDACTED]

3.3.1.4 Automated interface to location options (deferred)

[REDACTED]

3.3.2 DoE GIS interface

3.3.2.1 DOE interactive GIS

[REDACTED]

3.3.2.2 Analysis origins and arrivals exchange format

[REDACTED]

3.3.2.3 GIS access to user database

[REDACTED]

[REDACTED]

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[REDACTED]

[REDACTED]

[REDACTED]

3.4 System internal interface requirements

3.4.1 Data available for BARM analysis

[REDACTED]

3.4.2 Management of BARM configuration data

[REDACTED]

3.4.3 BARM short-term processing store

[REDACTED]

3.5 System internal data requirements

3.5.1 Data format of BARM results

The results of BARM processing shall be stored in formats specified by the US NDC database schema version in effect at the time of Phase 1 Upgrade system acceptance testing.

3.5.2 Support of DOE library in archive preparation

[REDACTED]

3.5.3 Geographical data formats

[REDACTED] AF b(2)
AF b(3)

3.5.4 Formats of stored waveform data

The US NDC shall store all waveform data in the following formats: CSS 3.0 (wfdisc format).

3.6 Adaptation requirements

There are no adaptation requirements.

3.7 Safety requirements

There are no new safety requirements for the Phase 1 Upgrade.

3.8 Security and privacy requirements

3.8.1 Security for upgrade system

The Phase 1 Upgrade system shall meet the security requirements as listed in the Phase 1 SRD.

3.9 System environment requirements

There are no new system environment requirements for the Phase 1 Upgrade.

3.10 Computer resource requirements

3.10.1 Computer hardware requirements

3.10.1.1 Hardware compatibility

The Phase 1 Upgrade system shall utilize hardware compatible with the US NDC Phase 1 system.

3.10.2 Computer hardware resource utilization requirements

3.10.2.1 Storage for DOE travel-time correction surfaces

[REDACTED]

3.10.2.2 Storage of geographical data

[REDACTED] AF b(2)
AF b(3)

3.10.2.3 Unclassified data acquisition processing load

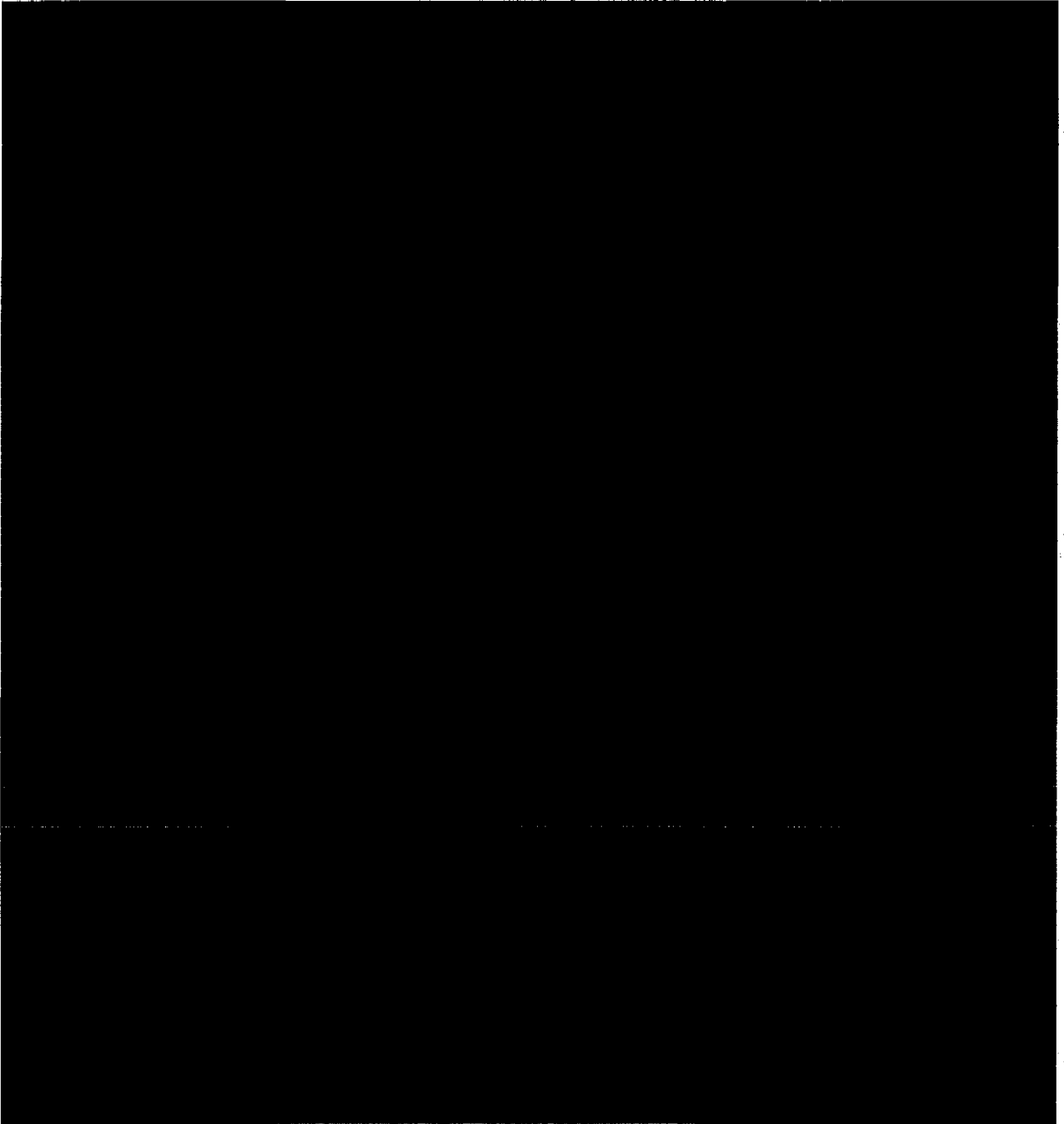
The UDAS processing load shall not exceed 50% of CPU processing capacity.

3.10.2.4 Unclassified database processing load

[REDACTED]

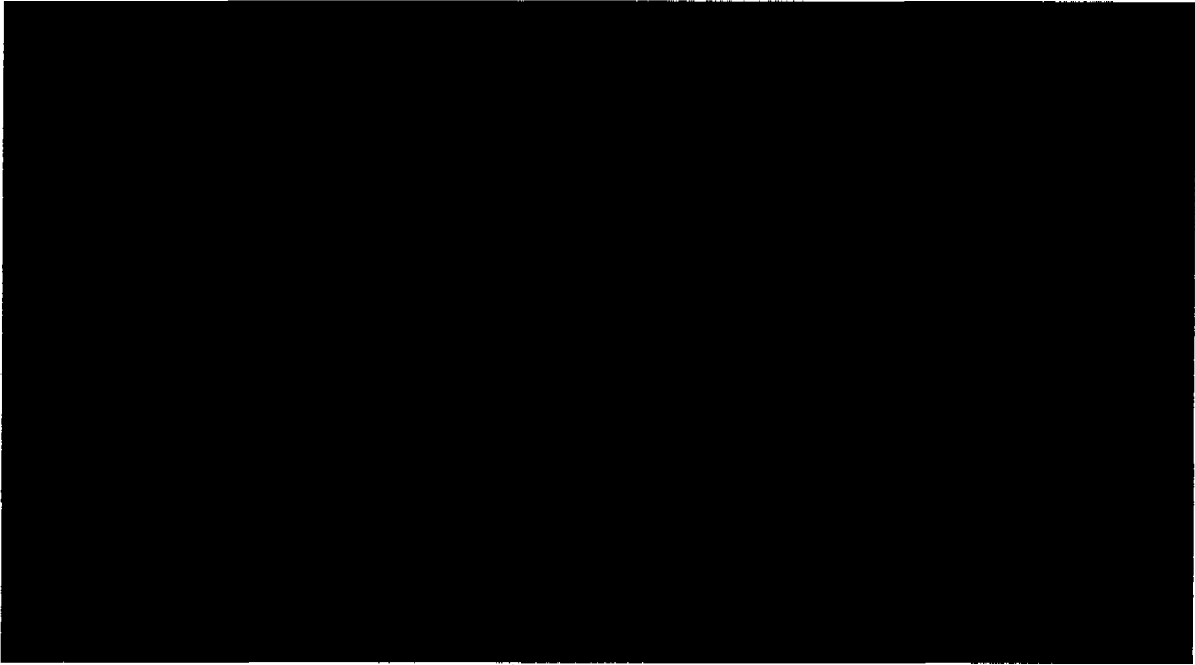
3.10.2.5 Unclassified data acquisition storage

The UDAS shall provide a combined Short-Term and Intermediate-Term storage capability of at least 130 GB and a minimum of 10 days for unprocessed waveform data received at a rate of 13 GB/day, with the capability to expand to the storage capability required for 10 days of unprocessed waveform data received at 18 GB/day.



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3.10.3 Computer software requirements

There are no computer software requirements.

3.10.4 Computer communications requirements

There are no computer communications requirements.

3.11 System quality factors

There are no system quality factors.

3.12 Design and construction constraints

There are no design and construction constraints.

3.13 Personnel-related requirements

There are no personnel-related requirements.

3.14 Training-related requirements

3.14.1 Operator training for BARM

The US NDC shall provide operator training to system operators for monitoring BARM processes.

3.14.2 BARM analysis training

The US NDC shall provide training to analysis personnel on the access and manipulation of any BARM-related data and tools.

3.14.3 Training for the DOE location library

The US NDC shall provide analyst instructions concerning how the location options are selected.

3.14.4 Training for the DOE GIS

The US NDC shall provide evaluator training on the use of the DOE GIS.

3.15 Logistics-related requirements**3.15.1 Logistics for upgrade system**

The Phase 1 Upgrade system shall meet the logistics-related requirements as listed in the Phase 1 SRD.

3.16 Other requirements**3.16.1 Maintenance of DOE location library**

The US NDC shall maintain the DOE location library as part of the system baseline.

3.16.2 Maintenance of DOE GIS

The US NDC shall maintain the DOE GIS as part of the system baseline.

3.17 Packaging requirements

There are no packaging requirements.

3.18 Precedence and criticality of requirements

There is no precedence to the requirements.

4.0 Qualification provisions

This section defines the qualification method for each requirement. The qualification methods defined can be any combination of

- Inspection
- Analysis
- Test
- Demonstration

Table 4.1 lists all requirements and their qualification method.

TABLE 4.1: QUALIFICATION MATRIX

SSS Requirement #	SSS Requirement Name	I	A	T	D
3.2.1.1	Broad Area Regional Processing				D
3.2.1.2	Scope of BARM region	I			D
3.2.1.3	BARM network	I			
3.2.1.4	BARM event detection threshold				D
3.2.1.5	Availability of BARM results				D
3.2.1.6	BARM automatic bulletin				D

SSS Requirement #	SSS Requirement Name	I	A	T	D
3.2.1.7	BARM final bulletin	I			
3.2.2.1	BARM signal detection	I			
3.2.2.2	BARM detection features	I			
3.2.2.3	BARM initial phase grouping				D
3.2.2.4	BARM initial regional phase identification				D
3.2.2.5	BARM initial teleseismic phase identification				D
3.2.2.6	BARM network phase grouping				D
3.2.2.7	BARM network phase identification				D
3.2.2.8	BARM restricted network processing search	I			
3.2.2.9	Automatic BARM location				D
3.2.2.10	BARM regional travel-time tables				D
3.2.2.11	BARM m _b magnitude				D
3.2.2.12	BARM regional magnitude				D
3.2.2.13	BARM detection beams				D
3.2.2.14	BARM origin beams				D
3.2.2.15	Analyst access to regional travel-time tables				D
3.2.2.16	Configurability of BARM				D
3.2.3.1	BARM signal detection performance monitoring				D
3.2.3.2	BARM feature extraction performance monitoring				D
3.2.3.3	BARM regional phase identification performance monitoring				D
3.2.3.4	BARM automatic association performance monitoring				D
3.2.3.5	BARM interactive analysis performance monitoring				D
3.2.3.6	BARM bulletin comparison				D
3.2.4.1	Support for existing location capabilities				D
3.2.4.2	Application of DOE travel-time correction surfaces				D
3.2.4.3	GIS display of analysis origins and arrivals				D
3.2.5.3	Simultaneous spotlight processing		A		D
3.2.5.4	Simultaneous look-forward processing		A		D
3.2.5.5	Look-forward processing station selection flexibility	I			D
3.2.5.6	Station capacity for teleseismic global processing		A		
3.2.5.7	Station capacity for hydroacoustic processing		A		
3.3.1.1	Interface to DOE travel-time correction library	I			
3.3.1.2	Access to DOE correction surfaces	I			D
3.3.1.3	Analyst interface to location options				D
3.3.1.4	Automated interface to location options (deferred)				D
3.3.2.1	DOE interactive GIS				D
3.3.2.2	Analysis origins and arrivals exchange format				D
3.3.2.3	GIS access to user database				D

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SSS Requirement #	SSS Requirement Name	I	A	T	D
3.4.1	Data available for BARM analysis				D
3.4.2	Management of BARM configuration data	I	A		
3.4.3	BARM short-term processing store				D
3.5.1	Data format of BARM results	I			
3.5.2	Support of DOE library in archive preparation	I			D
3.5.3	Geographical data formats	I			
3.5.4	Formats of stored waveform data				D
3.8.1	Security for upgrade system	I			
3.10.1.1	Hardware compatibility	I			
3.10.2.1	Storage for DOE travel-time correction surfaces	I			
3.10.2.2	Storage of geographical data	I			
3.14.1	Operator training for BARM	I			
3.14.2	BARM analysis training	I			
3.14.3	Training for the DOE location library	I			
3.14.4	Training for the DOE GIS	I			
3.15.1	Logistics for upgrade system		A		
3.16.1	Maintenance of DOE location library	I			
3.16.2	Maintenance of DOE GIS	I			

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AF b(3)

5.0 Requirements traceability


This section traces the specifications to system requirements. Table 5.1 identifies the SRD requirements related to each SSS specification. Table 5.2 identifies the SSS specification derived from each SRD requirement.

TABLE 5.1: SSS TRACEABILITY MATRIX

SSS Requirement #	SSS Requirement Name	SRD Requirement #
3.2.1.1	Broad Area Regional Processing	RI3.4.4.5.a
3.2.1.2	Scope of BARM region	RI3.4.4.5.a
3.2.1.2	Scope of BARM region	RI3.4.4.5.b
3.2.1.3	BARM network	RI3.4.4.5.a
3.2.1.4	BARM event detection threshold	RI3.4.4.5.a
3.2.1.5	Availability of BARM results	RI3.4.4.5.d
3.2.1.6	BARM automatic bulletin	RI3.4.4.5.a
3.2.1.7	BARM final bulletin	RI3.4.4.5.a
3.2.2.1	BARM signal detection	RI3.4.4.5.a
3.2.2.1	BARM signal detection	RI3.4.6.d
3.2.2.2	BARM detection features	RI3.4.4.5.a
3.2.2.2	BARM detection features	RI3.4.7.c
3.2.2.2	BARM detection features	RI3.4.7.d
3.2.2.2	BARM detection features	RI3.4.7.a
3.2.2.2	BARM detection features	RI3.4.7.a
3.2.2.3	BARM initial phase grouping	RI3.4.4.5.a
3.2.2.4	BARM initial regional phase identification	RI3.4.4.5.a
3.2.2.4	BARM initial regional phase identification	RI3.4.9.a
3.2.2.5	BARM initial teleseismic phase identification	RI3.4.4.5.a
3.2.2.5	BARM initial teleseismic phase identification	RI3.4.8.b
3.2.2.5	BARM initial teleseismic phase identification	RI3.4.8.c
3.2.2.6	BARM network phase grouping	RI3.4.4.5.a
3.2.2.6	BARM network phase grouping	RI3.4.9.b
3.2.2.7	BARM network phase identification	RI3.4.4.5.a
3.2.2.7	BARM network phase identification	RI3.4.8.d
3.2.2.8	BARM restricted network processing search	RI3.4.4.5.a
3.2.2.9	Automatic BARM location	RI3.4.4.5.a
3.2.2.10	BARM regional travel-time tables	RI3.4.4.5.a
3.2.2.11	BARM mb magnitude	RI3.4.4.5.a
3.2.2.11	BARM mb magnitude	RI3.4.11.a
3.2.2.12	BARM regional magnitude	RI3.4.4.5.a
3.2.2.12	BARM regional magnitude	RI3.4.11.a
3.2.2.13	BARM detection beams	RI3.4.4.5.a
3.2.2.13	BARM detection beams	RI3.4.6.c
3.2.2.14	BARM origin beams	RI3.4.4.5.a

SSS Requirement #	SSS Requirement Name	SRD Requirement #
3.2.2.14	BARM origin beams	RI3.4.13.1.b
3.2.2.15	Analyst access to regional travel-time tables	RI3.4.4.5.a
3.2.2.16	Configurability of BARM	RI3.4.4.5.c
3.2.3.1	BARM signal detection performance monitoring	RI3.4.4.5.a
3.2.3.1	BARM signal detection performance monitoring	RI3.9.1.b
3.2.3.2	BARM feature extraction performance monitoring	RI3.4.4.5.a
3.2.3.2	BARM feature extraction performance monitoring	RI3.9.1.b
3.2.3.3	BARM regional phase identification performance monitoring	RI3.4.4.5.a
3.2.3.3	BARM regional phase identification performance monitoring	RI3.9.1.b
3.2.3.4	BARM automatic association performance monitoring	RI3.4.4.5.a
3.2.3.4	BARM automatic association performance monitoring	RI3.9.1.b
3.2.3.5	BARM interactive analysis performance monitoring	RI3.4.4.5.a
3.2.3.5	BARM interactive analysis performance monitoring	RI3.9.1.b
3.2.3.6	BARM bulletin comparison	RI3.4.4.5.a
3.2.3.6	BARM bulletin comparison	RI3.9.1.b
3.2.4.1	Support for existing location capabilities	RI3.4.10.a
3.2.4.1	Support for existing location capabilities	RI3.4.10.b
3.2.4.1	Support for existing location capabilities	RI3.4.10.c
3.2.4.1	Support for existing location capabilities	RI3.4.10.d
3.2.4.1	Support for existing location capabilities	RI3.4.10.e
3.2.4.1	Support for existing location capabilities	RI3.4.10.f
3.2.4.1	Support for existing location capabilities	RI3.4.10.g
3.2.4.1	Support for existing location capabilities	RI3.4.10.h
3.2.4.2	Application of DOE travel-time correction surfaces	RI3.4.4.5.a
3.2.4.3	GIS display of analysis origins and arrivals	RI3.4.12.1.h
3.2.4.3	GIS display of analysis origins and arrivals	RI3.4.12.1.k
3.2.5.3	Simultaneous spotlight processing	RI3.4.4.4.b
3.2.5.4	Simultaneous look-forward processing	RI3.4.4.2.b
3.2.5.5	Look-forward processing station selection flexibility	RI3.4.4.2.f
3.2.5.6	Station capacity for teleseismic global processing	RI2.1.c.1
3.2.5.6	Station capacity for teleseismic global processing	RI3.4.4.1.b

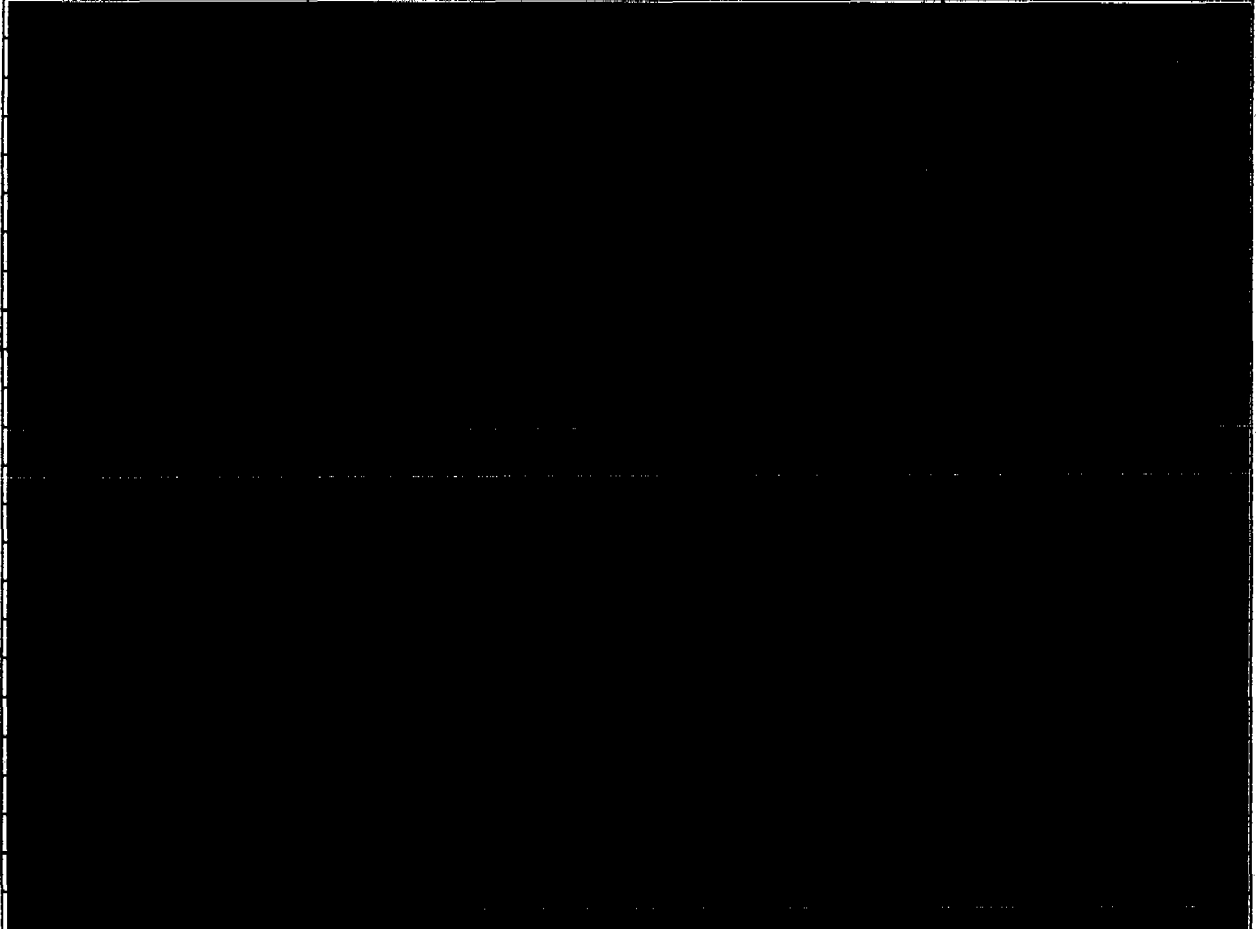
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SSS Requirement #	SSS Requirement Name	SRD Requirement #
3.2.5.7	Station capacity for hydroacoustic processing	RI2.1.c.1
3.3.1.1	Interface to DOE travel-time correction library	RI3.4.4.5.a
3.3.1.2	Access to DOE correction surfaces	RI3.4.4.5.a
3.3.1.3	Analyst interface to location options	RI3.4.10.a
3.3.1.3	Analyst interface to location options	RI3.4.10.b
3.3.1.3	Analyst interface to location options	RI3.4.10.c
3.3.1.3	Analyst interface to location options	RI3.4.10.d
3.3.1.3	Analyst interface to location options	RI3.4.10.e
3.3.1.3	Analyst interface to location options	RI3.4.10.f
3.3.1.3	Analyst interface to location options	RI3.4.10.g
3.3.1.3	Analyst interface to location options	RI3.4.10.h
3.3.1.4	Automated interface to location options (deferred)	RI3.4.10.a
3.3.1.4	Automated interface to location options (deferred)	RI3.4.10.b
3.3.1.4	Automated interface to location options (deferred)	RI3.4.10.c
3.3.1.4	Automated interface to location options (deferred)	RI3.4.10.d
3.3.1.4	Automated interface to location options (deferred)	RI3.4.10.e
3.3.1.4	Automated interface to location options (deferred)	RI3.4.10.f
3.3.1.4	Automated interface to location options (deferred)	RI3.4.10.g
3.3.1.4	Automated interface to location options (deferred)	RI3.4.10.h
3.3.2.1	DOE interactive GIS	RI3.4.12.4.a
3.3.2.1	DOE interactive GIS	RI3.4.12.4.b
3.3.2.1	DOE interactive GIS	RI3.4.12.4.c
3.3.2.2	Analysis origins and arrivals exchange format	RI3.4.12.1.h
3.3.2.2	Analysis origins and arrivals exchange format	RI3.4.12.1.k
3.3.2.3	GIS access to user database	RI3.4.12.4.a
		
3.4.1	Data available for BARM analysis	RI3.4.4.5.a
3.4.2	Management of BARM configuration data	RI3.4.4.5.a
3.4.3	BARM short-term processing store	RI3.4.4.5.a
3.5.1	Data format of BARM results	RI3.4.4.5.a

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SSS Requirement #	SSS Requirement Name	SRD Requirement #
3.5.2	Support of DOE library in archive preparation	RI3.4.10.c
3.5.2	Support of DOE library in archive preparation	RI3.4.10.f
3.5.2	Support of DOE library in archive preparation	RI3.4.10.g
3.5.3	Geographical data formats	RI3.4.12.4.b
3.5.4	Formats of stored waveform data	RI2.1.c.1
3.8.1	Security for upgrade system	RI5.1.a
3.8.1	Security for upgrade system	RI5.1.b
3.8.1	Security for upgrade system	RI5.1.c
3.8.1	Security for upgrade system	RI5.1.d
3.8.1	Security for upgrade system	RI5.2.a
3.8.1	Security for upgrade system	RI5.2.1.a
3.8.1	Security for upgrade system	RI5.2.1.b
3.8.1	Security for upgrade system	RI5.2.1.c
3.8.1	Security for upgrade system	RI5.2.1.d
3.10.1.1	Hardware compatibility	RI4.a
3.10.1.1	Hardware compatibility	RI4.1.8.a
3.10.2.1	Storage for DOE travel-time correction surfaces	RI3.4.4.5.a
3.10.2.2	Storage of geographical data	RI3.4.12.4.b



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SSS Requirement #	SSS Requirement Name	SRD Requirement #
[REDACTED]		
3.14.1	Operator training for BARM	RI8.3.1.a
3.14.2	BARM analysis training	RI8.3.1.b
3.14.3	Training for the DOE location library	RI8.3.1.b
3.14.4	Training for the DOE GIS	RI8.3.1.b
3.15.1	Logistics for upgrade system	RI4.1.4.a
3.15.1	Logistics for upgrade system	RI4.1.5.a
3.15.1	Logistics for upgrade system	RI4.1.6.a
3.15.1	Logistics for upgrade system	RI4.1.6.b
3.15.1	Logistics for upgrade system	RI4.1.7.a
3.16.1	Maintenance of DOE location library	RI7.3.a
3.16.1	Maintenance of DOE location library	RI7.3.b
3.16.1	Maintenance of DOE location library	RI7.3.c
3.16.1	Maintenance of DOE location library	RI7.3.d
3.16.2	Maintenance of DOE GIS	RI7.3.a
3.16.2	Maintenance of DOE GIS	RI7.3.b
3.16.2	Maintenance of DOE GIS	RI7.3.c

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TABLE 5.2: SRD TRACEABILITY MATRIX

SRD Requirement #	SSS Requirement #	SSS Requirement Name
[REDACTED]		
RI2.1.c.1	3.2.5.6	Station capacity for teleseismic global processing
RI2.1.c.1	3.2.5.7	Station capacity for hydroacoustic processing
RI2.1.c.1	3.3.3.1	Unclassified waveform data acquisition
[REDACTED]		

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SRD Requirement #	SSS Requirement #	SSS Requirement Name
RI3.1.1.1.c	3.3.3.2	Formats of acquired unclassified waveform data
RI3.4.4.5.a	3.2.1.1	Broad Area Regional Processing
RI3.4.4.5.a	3.2.1.2	Scope of BARM region
RI3.4.4.5.a	3.2.1.3	BARM network
RI3.4.4.5.a	3.2.1.4	BARM event detection threshold
RI3.4.4.5.a	3.2.1.6	BARM automatic bulletin
RI3.4.4.5.a	3.2.1.7	BARM final bulletin
RI3.4.4.5.a	3.2.2.1	BARM signal detection
RI3.4.4.5.a	3.2.2.10	BARM regional travel-time tables
RI3.4.4.5.a	3.2.2.11	BARM mb magnitude
RI3.4.4.5.a	3.2.2.12	BARM regional magnitude
RI3.4.4.5.a	3.2.2.13	BARM detection beams
RI3.4.4.5.a	3.2.2.14	BARM origin beams
RI3.4.4.5.a	3.2.2.15	Analyst access to regional travel-time tables
RI3.4.4.5.a	3.2.2.2	BARM detection features
RI3.4.4.5.a	3.2.2.3	BARM initial phase grouping

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SRD Requirement #	SSS Requirement #	SSS Requirement Name
RI3.4.4.5.a	3.2.2.4	BARM initial regional phase identification
RI3.4.4.5.a	3.2.2.5	BARM initial teleseismic phase identification
RI3.4.4.5.a	3.2.2.6	BARM network phase grouping
RI3.4.4.5.a	3.2.2.7	BARM network phase identification
RI3.4.4.5.a	3.2.2.8	BARM restricted network processing search
RI3.4.4.5.a	3.2.2.9	Automatic BARM location
RI3.4.4.5.a	3.2.3.1	BARM signal detection performance monitoring
RI3.4.4.5.a	3.2.3.2	BARM feature extraction performance monitoring
RI3.4.4.5.a	3.2.3.3	BARM regional phase identification performance monitoring
RI3.4.4.5.a	3.2.3.4	BARM automatic association performance monitoring
RI3.4.4.5.a	3.2.3.5	BARM interactive analysis performance monitoring
RI3.4.4.5.a	3.2.3.6	BARM bulletin comparison
RI3.4.4.5.a	3.2.4.2	Application of DOE travel-time correction surfaces
RI3.4.4.5.a	3.3.1.1	Interface to DOE travel-time correction library
RI3.4.4.5.a	3.3.1.2	Access to DOE correction surfaces
RI3.4.4.5.a	3.4.1	Data available for BARM analysis
RI3.4.4.5.a	3.4.2	Management of BARM configuration data
RI3.4.4.5.a	3.4.3	BARM short-term processing store
RI3.4.4.5.a	3.5.1	Data format of BARM results
RI3.4.4.5.b	3.2.1.2	Scope of BARM region
RI3.4.4.5.c	3.2.2.16	Configurability of BARM
RI3.4.4.5.d	3.2.1.5	Availability of BARM results
RI3.4.6.c	3.2.2.13	BARM detection beams
RI3.4.6.d	3.2.2.1	BARM signal detection
RI3.4.7.a	3.2.2.2	BARM detection features
RI3.4.7.a	3.2.2.2	BARM detection features
RI3.4.7.c	3.2.2.2	BARM detection features
RI3.4.7.d	3.2.2.2	BARM detection features
RI3.4.8.b	3.2.2.5	BARM initial teleseismic phase identification
RI3.4.8.c	3.2.2.5	BARM initial teleseismic phase identification
RI3.4.8.d	3.2.2.7	BARM network phase identification
RI3.4.9.a	3.2.2.4	BARM initial regional phase identification
RI3.4.9.b	3.2.2.6	BARM network phase grouping
RI3.4.10.a	3.2.4.1	Support for existing location capabilities

AF b(2)
AF b(3)

SRD Requirement #	SSS Requirement #	SSS Requirement Name
RI3.4.10.a	3.3.1.3	Analyst interface to location options
RI3.4.10.a	3.3.1.4	Automated interface to location options (deferred)
RI3.4.10.b	3.2.4.1	Support for existing location capabilities
RI3.4.10.b	3.3.1.3	Analyst interface to location options
RI3.4.10.b	3.3.1.4	Automated interface to location options (deferred)
RI3.4.10.c	3.2.4.1	Support for existing location capabilities
RI3.4.10.c	3.3.1.3	Analyst interface to location options
RI3.4.10.c	3.3.1.4	Automated interface to location options (deferred)
RI3.4.10.c	3.5.2	Support of DOE library in archive preparation
RI3.4.10.d	3.2.4.1	Support for existing location capabilities
RI3.4.10.d	3.3.1.3	Analyst interface to location options
RI3.4.10.d	3.3.1.4	Automated interface to location options (deferred)
RI3.4.10.e	3.2.4.1	Support for existing location capabilities
RI3.4.10.e	3.3.1.3	Analyst interface to location options
RI3.4.10.e	3.3.1.4	Automated interface to location options (deferred)
RI3.4.10.f	3.2.4.1	Support for existing location capabilities
RI3.4.10.f	3.3.1.3	Analyst interface to location options
RI3.4.10.f	3.3.1.4	Automated interface to location options (deferred)
RI3.4.10.f	3.5.2	Support of DOE library in archive preparation
RI3.4.10.g	3.2.4.1	Support for existing location capabilities
RI3.4.10.g	3.3.1.3	Analyst interface to location options
RI3.4.10.g	3.3.1.4	Automated interface to location options (deferred)
RI3.4.10.g	3.5.2	Support of DOE library in archive preparation
RI3.4.10.h	3.2.4.1	Support for existing location capabilities
RI3.4.10.h	3.3.1.3	Analyst interface to location options
RI3.4.10.h	3.3.1.4	Automated interface to location options (deferred)
RI3.4.11.a	3.2.2.11	BARM mb magnitude
RI3.4.11.a	3.2.2.12	BARM regional magnitude
RI3.4.12.1.h	3.2.4.3	GIS display of analysis origins and arrivals
RI3.4.12.1.h	3.3.2.2	Analysis origins and arrivals exchange format
RI3.4.12.1.k	3.2.4.3	GIS display of analysis origins and arrivals
RI3.4.12.1.k	3.3.2.2	Analysis origins and arrivals exchange format
RI3.4.12.4.a	3.3.2.1	DOE interactive GIS
RI3.4.12.4.a	3.3.2.3	GIS access to user database
RI3.4.12.4.b	3.10.2.2	Storage of geographical data

SRD Requirement #	SSS Requirement #	SSS Requirement Name
RI3.4.12.4.b	3.3.2.1	DOE interactive GIS
RI3.4.12.4.b	3.5.3	Geographical data formats
RI3.4.12.4.c	3.3.2.1	DOE interactive GIS
RI3.4.13.1.b	3.2.2.14	BARM origin beams
RI3.9.1.b	3.2.3.1	BARM signal detection performance monitoring
RI3.9.1.b	3.2.3.2	BARM feature extraction performance monitoring
RI3.9.1.b	3.2.3.3	BARM regional phase identification performance monitoring
RI3.9.1.b	3.2.3.4	BARM automatic association performance monitoring
RI3.9.1.b	3.2.3.5	BARM interactive analysis performance monitoring
RI3.9.1.b	3.2.3.6	BARM bulletin comparison
RI4.a	3.10.1.1	Hardware compatibility
RI4.1.4.a	3.15.1	Logistics for upgrade system
RI4.1.5.a	3.15.1	Logistics for upgrade system
RI4.1.6.a	3.15.1	Logistics for upgrade system
RI4.1.6.b	3.15.1	Logistics for upgrade system
RI4.1.7.a	3.15.1	Logistics for upgrade system
RI4.1.8.a	3.10.1.1	Hardware compatibility
RI5.1.a	3.8.1	Security for upgrade system
RI5.1.b	3.8.1	Security for upgrade system
RI5.1.c	3.8.1	Security for upgrade system
RI5.1.d	3.8.1	Security for upgrade system
RI5.2.a	3.8.1	Security for upgrade system
RI5.2.1.a	3.8.1	Security for upgrade system
RI5.2.1.b	3.8.1	Security for upgrade system
RI5.2.1.c	3.8.1	Security for upgrade system
RI5.2.1.c	3.8.1	Security for upgrade system
RI7.3.a	3.16.1	Maintenance of DOE location library
RI7.3.a	3.16.2	Maintenance of DOE GIS
RI7.3.b	3.16.1	Maintenance of DOE location library
RI7.3.b	3.16.2	Maintenance of DOE GIS
RI7.3.c	3.16.1	Maintenance of DOE location library
RI7.3.c	3.16.2	Maintenance of DOE GIS
RI7.3.d	3.16.1	Maintenance of DOE location library
RI8.3.1.a	3.14.1	Operator training for BARM
RI8.3.1.b	3.14.2	BARM analysis training
RI8.3.1.b	3.14.3	Training for the DOE location library
RI8.3.1.b	3.14.4	Training for the DOE GIS

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